

THE PAN-PACIFIC ENTOMOLOGIST



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THREE NEW OLPIID PSEUDOSCORPIONS FROM CALIFORNIA (PSEUDOSCORPIONIDA, OLPIIDAE)

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Pseudoscorpions of the family Olpiidae are not well represented in the Pacific coast states. Benedict and Malcolm (1977) have recently discussed the distribution of *Pseudogarypinus frontalis* (Banks) in California, Oregon and Washington and of *Oreolpium nymphum* Benedict and Malcolm in Oregon alone. Other than these, there is only the single record of *Hesperolpium slevini* (Chamberlin) from El Centro, Imperial County, California (Chamberlin 1930). Due to the recent efforts of several active field biologists in central and southern California, 3 new species have been discovered. I am indebted to F. G. Andrews, K. W. Cooper and D. Giuliani for sending the specimens.

Family Olpiidae Chamberlin

With the following characteristics: all legs diplotarsate; movable finger of chelicera without marginal teeth; both chelal fingers with functional venom apparatus; coxal area parallel-sided; legs with arolia longer than claws.

Subfamily Olpiinae Banks

With these additional characteristics: all abdominal tergites entire; pedal arolia entire; often 1 or 2 trichobothria on dorsum of palpal femur; usually 3 setae in cheliceral flagellum.

Tribe Hesperolpiini Hoff

This tribe was defined by Hoff (1964:30) with *Hesperolpium slevini* (Chamberlin) as the type, and including the newly described *Aphelolpium scitulum* Hoff from Jamaica. The diagnostic characters are the long venom ducts in the chelal fingers and the first leg with telofemur distinctly shorter than basifemur.

The genus *Hesperolpium* was defined by Chamberlin (1930:606) on the basis of *Olpium slevini* Chamberlin from Baja California, Mexico. As mentioned above, only one record was cited for California; no further specimens have been reported. Because the original description of *H. slevini* was sketchy in many respects, it seems appropriate to report more complete data here.

Hesperolpium slevini (Chamberlin)

Olpium slevini Chamberlin, 1923:363–364.

Hesperolpium slevini, Chamberlin, 1930:607.

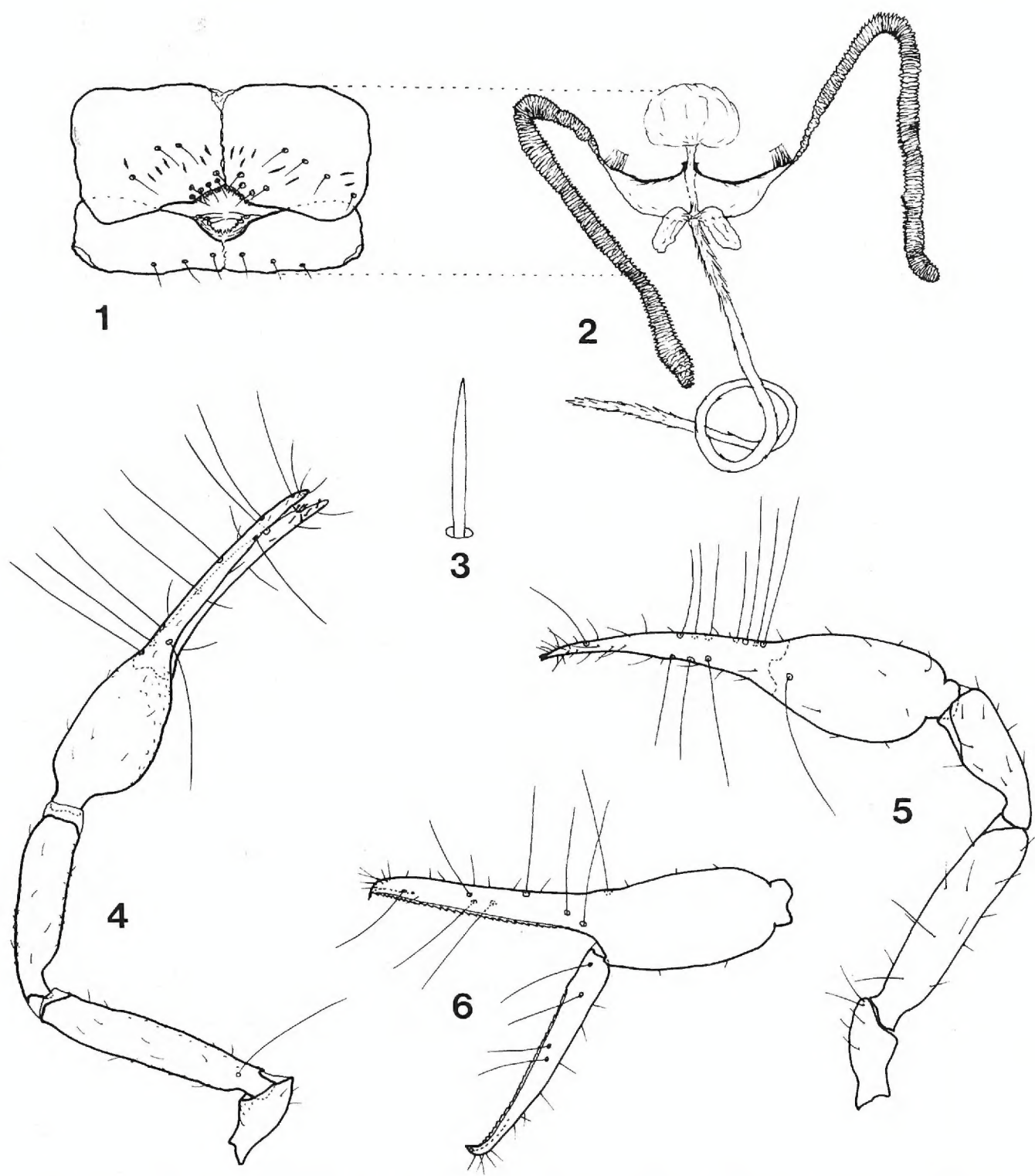
Material examined.—Holotype male (CAS Type 1272), allotype female and paratype female from Cuesta Blanca, near Loreto, Baja California, Mexico; and 11 other specimens from several locations in Baja California [California Academy of Sciences]. Also (new record), one male from Telegraph Pass, Yuma County, Arizona, 9 October 1963 (J. and W. Ivie) [American Museum of Natural History].

Description.—The original description of Chamberlin is fairly accurate as far as it goes and includes 4 figures. Additional illustrations are given in Chamberlin 1931:Figs. 2; 4,G; 16,F; 32,E; 37,N,O; 42,F,G. The following will supplement that information.

Males and females similar, but females somewhat larger and more robust. Surface of carapace finely granulate, especially laterally; setae very fine and difficult to count, probably about 30 in all and with 6–8 at anterior and 4 at posterior margin. Tergites and sternites entire; surfaces smooth; pleural membranes finely, longitudinally striate. Tergal chaetotaxy about 4:4:4:6:6:6:6:6:1T4T1:1T4T1:1T4T1:2. Sternal chaetotaxy of holotype male 14:[3–2]:(0)6(0):(0)8(0):8:9:9:8:8:2TT2:0:2; as Chamberlin points out (1923:363) the 11th sternite is weakly chitinized, and that part of the circumanal ring bears no setae. Distribution of setae on genital opercula and internal genitalia of male from Arizona shown in Figs. 1 and 2. Chaetotaxy of anterior sternites of female about 6:(0)6(0):(0)8(0):8:9:–.

Chelicera about $\frac{1}{3}$ as long as carapace; hand with 5 setae; flagellum of 1 large and 2 small setae, all dentate in distal halves; lamina exterior present; movable finger with subterminal lobe nearly lateral to terminal cusp; galea long, slender, trifid at tip; galeal seta inserted near base of galea.

Palps generally as indicated by Chamberlin. Proportions of segments variable: trochanter 2.1–2.3, femur 3.5–4.2, tibia 2.9–3.6, and chela (without pedicel) 3.1–3.9 times as long as broad; hand (without pedicel) about 1.5 times as long as deep; movable finger 1.35–1.65 times as long as hand. Small granules scattered over most of trochanter and femur and on medial sides of tibia and chelal hand. Most setae very small and inconspicuous. Palpal femur with a small but obvious trichobothrium on dorsum about $\frac{1}{4}$ length from proximal end. Trichobothria on chela as shown by Chamberlin (1931:Fig. 37,O). The group of small sensory setae near tip of movable chelal finger (Chamberlin, 1931:Fig. 37,N and O) numbering 4–12; distal and proximal to this group on the movable finger and in 2 or 3 longitudinal rows on the fixed finger are a number of short dagger-shaped setae (Fig. 3), somewhat similar to those described on *Aphelolpium* (Muchmore, 1979:202 and Fig. 19). Fixed finger with 45–55 contiguous, marginal teeth, most with



Figs. 1-6. Figs. 1-3, *Hesperolpium slevini* (Chamberlin): 1, Genital opercula of male; 2, Internal genitalia of male; 3, Dagger-shaped seta from palpal coxa. Fig. 4, *Hesperolpium andrewsi*, new species, holotype tritonymph: Dorsal aspect of left palp. Figs. 5 and 6, *Neoamblyolpium giulianii*, new species, holotype male: 5, Dorsal aspect of right palp; 6, Lateral aspect of left chela.

distinct cusps; movable finger with 40-45 teeth, less well developed and only about half of them (toward the distal end) with cusps. Both chelal fingers with well developed venom apparatus having long ducts (see Chamberlin, 1931:Fig. 32,E), the nodi ramosi situated well proximad of trichobothria *t* and *it*.

Legs not remarkable, except that the setae on the outer margins are very small and inconspicuous, allowing the heavier, inner setae described by Chamberlin (1923:363) to stand out by comparison. Arolia not divided, longer than claws.

Measurements (mm).—Figures given first are for the holotype male, followed in parentheses by ranges for 12 other specimens (male and female) from Baja California. Body length 2.95(3.2–5.2). Carapace length 0.93(0.89–1.26). Chelicera 0.30(0.27–0.36) long. Palpal femur 0.92(0.87–1.235) by 0.245(0.245–0.355); tibia 0.85(0.835–1.07) by 0.26(0.26–0.38); chela (without pedicel) 1.52(1.47–2.145) by 0.41(0.41–0.65); hand (without pedicel) 0.59(0.59–0.87) long; pedicel 0.12(0.11–0.15) long; movable finger 0.94(0.90–1.28) long. Leg IV: entire femur 0.79(0.75–1.07) by 0.30(0.29–0.36).

***Hesperolpium andrewsi*, new species**

(Fig. 4)

Material.—Holotype tritonymph (WM 5407.01001), taken in a pit trap in Eureka Valley, Inyo County, California, June 1978 (F. G. Andrews and D. Giuliani). The type is deposited in the California Academy of Sciences.

Diagnosis.—Similar to *Hesperolpium slevini* (Chamberlin) in most respects, but probably larger and with distinctly more slender appendages.

Description of tritonymph.—With the characters of the family Olpiidae, subfamily Olpiinae, and tribe Hesperolpiini (Hoff, 1964:30) and with the following particular features. Palps light brown, other parts tan. Carapace 1.65 times as long as broad, distinctly narrowed in front of eyes; surface smooth; 4 corneate eyes; about 24 small, inconspicuous setae, 6 at anterior and 4 at posterior margin. Coxal area typical, parallel-sided. Abdomen typical; tergites and sternites entire; pleural membranes finely, longitudinally striate. Tergal chaetotaxy 2:2:5:4:5:4:6:6:5:T2T:1T4T1:2. Sternal chaetotaxy 2:(0)5(0):(0)6(0):6:6:6:6:6:2TT2:0:2.

Chelicera 0.3 as long as carapace; hand with 5 setae; flagellum of 3 setae, the large, distal one strongly dentate; lamina exterior present; fixed finger with 6 small teeth; movable finger with subapical lobe; galea slender, with 3 small rami; galeal seta set near base of galea; serrula exterior with 18 or 19 blades.

Palp rather slender (Fig. 4); trochanter 2.2, femur 5.05, tibia 3.95, and chela (without pedicel) 4.6 times as long as broad; hand (without pedicel) 1.9 times as long as deep; movable finger 1.7 times as long as hand. Femur 1.11 and chela 1.75 times as long as carapace. Tiny granules scattered sparsely over trochanter and femur and on medial sides of tibia and chelal hand. Most setae small and inconspicuous. Femur with a trichobothrium on the dorsum about $\frac{1}{4}$ length of segment from proximal end. Trichobothria on chela as shown in Fig. 4; only 10 present as is usual in tritonymphs, the

missing ones apparently *sb* and *ist*. Movable finger with a group of 15–18 short, spatulate setae in a shallow depression on the lateral side, distal to trichobothrium *t*; as in *H. slevini*, there are short dagger-shaped setae near this group and on fixed finger. Both fingers with well developed venom teeth and venom apparatus; ducts slender and long; the nodi ramosi just distal to trichobothrium *it* and just proximal to *t*.

Legs typical. Leg I with basifemur 1.95 times as long as telofemur. Leg IV with entire femur 4.4 and tibia 6.5 times as long as deep. Arolia not divided, longer than claws. Subterminal tarsal setae simple.

Male and female.—Unknown.

Measurements (mm).—Body length 3.16 mm. Carapace length 0.865; greatest breadth 0.52. Chelicera 0.26 by 0.15. Palpal trochanter 0.405 by 0.185; femur 0.90 by 0.195; tibia 0.79 by 0.20; chela (without pedicel) 1.515 by 0.33; hand (without pedicel) 0.57 by 0.30; pedicel 0.08 long; movable finger 0.975 long. Leg I: basifemur 0.445 by 0.095; telofemur 0.23 by 0.09; leg IV: entire femur 0.815 by 0.185; tibia 0.62 by 0.095; metatarsus 0.325 by 0.06; telotarsus 0.25 by 0.05.

Etymology.—The species is named for Dr. Fred G. Andrews, who helped collect and kindly sent the specimen.

Remarks.—Though it is usually not good practice to describe species of pseudoscorpions on the basis of nymphs, this form is so clearly different from *H. slevini* that it deserves recognition. This tritonymph is nearly as large as the smaller males of *H. slevini*, and the palps and legs are all more slender than those of any *H. slevini* adult.

Subfamily Garypininae Daday

Distinguished by these characters: at least some abdominal tergites medially divided; pedal arolia divided; 4 setae in cheliceral flagellum.

The genus *Neoamblyolpium* was described by Hoff (1956:27) on the basis of *N. alienum* Hoff from north central New Mexico. That species was also reported from a wide area of the Rocky Mountains in Colorado (Hoff, 1961), but has not been reported subsequently.

Neoamblyolpium giulianii, new species (Figs. 5 and 6)

Material.—Holotype female (WM 4887.01001) from berlese extraction of *Cercocarpus* duff at 8300 feet, 10 miles south of Independence, Inyo County, California, 2 January 1976 (D. Giuliani). The type is in the Florida State Collection of Arthropods, Gainesville.

Diagnosis.—Similar to *Neoamblyolpium alienum* Hoff, but larger and with more slender appendages; palpal femur 0.525 mm long and 4.4 times as long as broad.

Description of female (male unknown).—With the characters of the genus (see Hoff, 1956:27). Generally light brown to tan; all surfaces smooth. Carapace longer than broad; poorly sclerotized posteriorly; anterior margin slightly convex; with four large corneate eyes; chaetotaxy 4-4-2-2-2-2-4 = 20.

Abdomen elongate; tergites 2–10 and sternites 3–10 divided; pleural membranes longitudinally wrinkled; tergal chaetotaxy 6:5:6:6:6:6:8:6:8:T2 T2T2T:TTTT:2; sternal chaetotaxy 8:(0)6(0):(1)8(1):8:10:10:9:9:T2T2T2 T:1TT1:2. Disposition of setae on genital opercula as in *N. alienum*; lateral and median cribriform plates present but obscure.

Chelicera 0.3 as long as carapace; hand with 5 long, acuminate setae; flagellum of 4 subequal setae, the distal one terminally dentate; no lamina exterior is evident; serrula exterior of 16 or 17 blades; tip of movable finger incised; galea long, slender, terminally trifid.

Palp slender (Fig. 5); femur 0.87 and chela 1.47 times as long as carapace; trochanter 2.25, femur 4.4, tibia 2.55 and chela (without pedicel) 4.05 times as long as broad; hand (without pedicel) 1.75 times as long as deep; movable finger 1.42 times as long as hand. There are 4 or 5 setae on the dorsum of the femur, but none is conspicuously larger than the others. Trichobothria on chela shown in Fig. 6, much as in *N. alienum* but *ist* slightly closer to *it* than to *isb*. Fixed chelal finger with 29 cusped teeth; movable finger with 23 more weakly developed teeth, lacking cusps in proximal half of row. Both fingers with well developed venom apparatus.

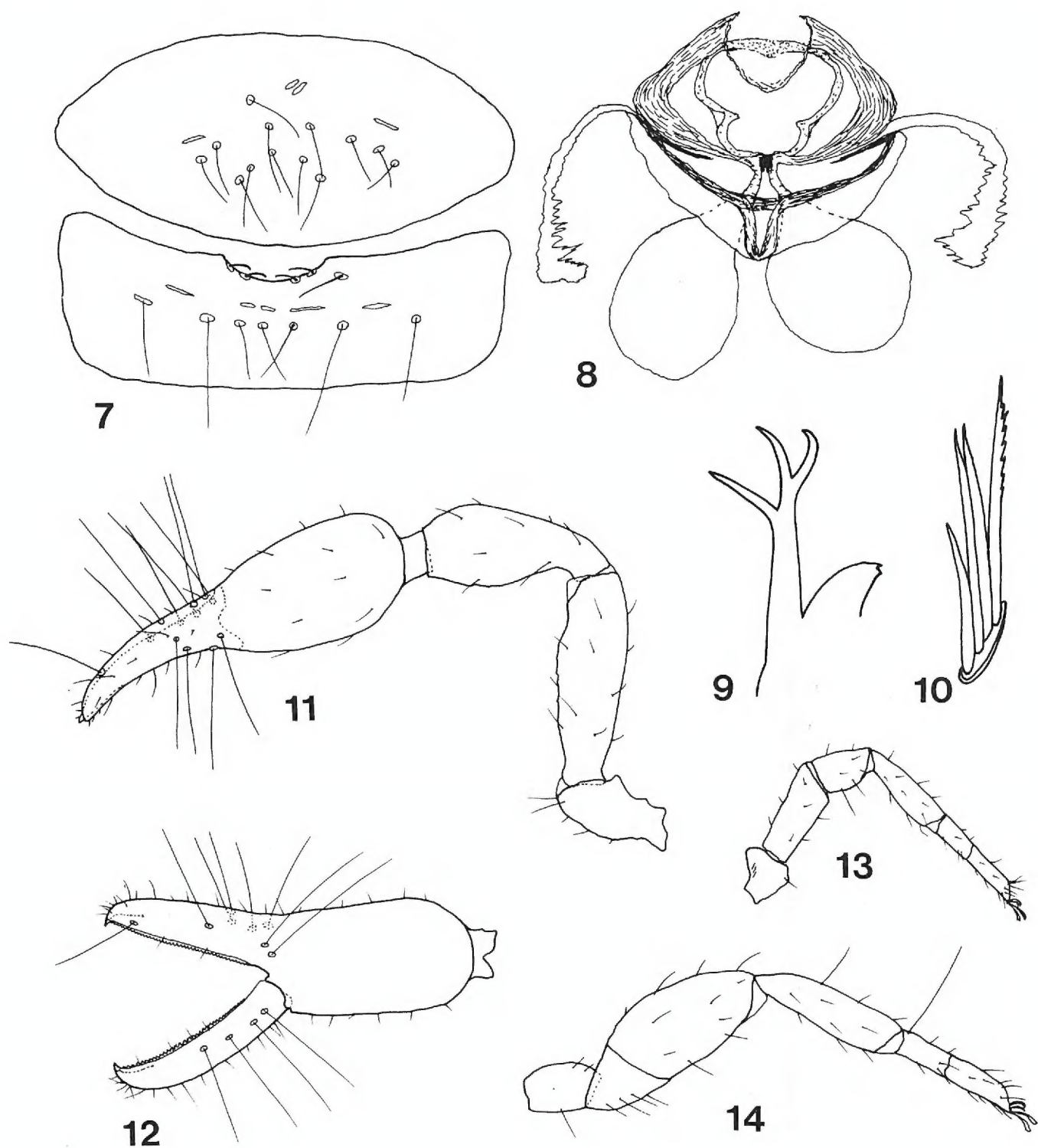
Legs rather slender. Leg I with basifemur 2 times as long as telofemur. Leg IV with entire femur 2.95 and tibia 4.05 times as long as deep. Arolia longer than claws and bifid.

Measurements (mm).—Body length 2.30. Carapace length 0.605. Chelicera 0.185 by 0.105. Palpal trochanter 0.25 by 0.11; femur 0.525 by 0.12; tibia 0.33 by 0.13; chela (without pedicel) 0.89 by 0.22; hand (without pedicel) 0.37 by 0.21; pedicel 0.045 long; movable finger 0.525 long. Leg I: basifemur 0.26 by 0.085; telofemur 0.125 by 0.075. Leg IV: entire femur 0.47 by 0.16; tibia 0.325 by 0.08; metatarsus 0.16 by 0.06; telotarsus 0.19 by 0.045.

Etymology.—The species is named for Derham Giuliani, who collected the specimen.

Remarks.—This is the second described species of the genus *Neoamblyolpium*. The type species, *N. alienum*, is known only from juniper, pinon and yellow pine litter in the Rocky Mountains in New Mexico and Colorado, where it has been found only at altitudes of 6000–7500 feet (Hoff, 1956, 1959, 1961).

The genus *Pseudogarypinus* Beier has recently been reviewed by Benedict and Malcolm (1977) in regard to its occurrence in the United States. Two species are recognized, the widespread *P. frontalis* (Banks) and the rare *P. giganteus* Hoff.



Figs. 7–14. *Pseudogarypinus cooperi*, new species: Fig. 7, Genital opercula of male; Fig. 8, Internal genitalia of male; Fig. 9, Galea of male; Fig. 10, Flagellum; Fig. 11, Dorsal aspect of right palp; Fig. 12, Lateral aspect of left chela; Fig. 13, Leg I; Fig. 14, Leg IV.

***Pseudogarypinus cooperi*, new species**
(Figs. 7–14)

Material.—Holotype male (WM 4729.02001) from juniper litter below *Neotoma fuscipes* nest in the Gavilan Hills, south of Riverside, Riverside County, California, 20 March 1977 (K. W. Cooper); 19 paratypes, of both sexes, from several localities in Riverside, San Bernardino and San Diego

Counties, California, usually in close association with pack rats (K. W. Cooper and J. A. Moore). The types are in the Florida State Collection of Arthropods, Gainesville.

Diagnosis.—The smallest known species of the genus, with palpal femur less than 0.7 mm in length.

Description.—Males and females similar, though females slightly larger. Carapace and palps light reddish brown, other parts much lighter. Carapace longer than broad; surface smooth; 4 corneate eyes; 24–26 setae, with 4 near anterior and 4 near posterior margin. Coxal area typical of genus. Abdomen long, narrow; tergites 2–10 and sternites 4–10 divided; pleural membranes longitudinally finely striate. Tergal chaetotaxy variable, but about 6:6:7:7:7:8:8:7:6:T1T2T1T:1T2T1:2. Sternal chaetotaxy of holotype male 14:(3)2–3/10(3):(2)7(2):9:8:9:9:8:T2T2T2T:2T2T2:2; genital opercula and internal genitalia of male as in Figs. 7 and 8. Anterior genital operculum of female with 9–11 setae on surface and posterior operculum with 9 or 10 setae; spiracular plates with 2 or 3 setae; cribriform plates variable, but generally similar to those of *P. frontalis* (Benedict and Malcolm, 1977:Fig. 17).

Chelicera about 0.35 as long as carapace; hand with 5 long setae; flagellum of 4 setae, of different lengths, and distal one dentate (Fig. 10); fixed finger with 6 small teeth; apical tooth of movable finger slightly incised, subapical lobe heavy; narrow lamina exterior present; galea slender, with 1 lateral and 2 terminal rami (Fig. 9); serrula exterior of 19 or 20 blades.

Palp moderately slender, with femur distinctively narrowed distally (Fig. 11). Femur 3.0–3.7, tibia 2.05–2.35, and chela (without pedicel) 2.85–3.4 times as long as broad; hand (without pedicel) 1.55–1.9 times as long as deep; movable finger 0.90–1.0 times as long as hand. Surfaces mostly smooth, but few small granules medially on femur, tibia and chelal hand. Trichobothria of chela as in Fig. 12; *isb* slightly closer to *ib* than to *ist*. Fixed chelal finger with 35–40 distinct, cusped marginal teeth; movable finger with about same number of similar teeth, though cusps become obsolete proximally in row. Both fingers with well developed venom apparatus; ducts long and narrow, each nodus ramosus about $\frac{1}{5}$ length of finger from distal end.

Legs rather robust; leg I with basifemur 1.6–1.7 times as long as telofemur (Fig. 13); leg IV with entire femur 2.5–2.8 and tibia 3.25–3.55 times as long as deep (Fig. 14). Tibia of leg IV with a short, and metatarsus with a very long, tactile seta. Arolia longer than claws and deeply divided.

Measurements (mm).—Figures given first are for the holotype male, followed in parentheses by ranges for the other available specimens, both male and female. Body length 2.7(2.55–3.25). Carapace length 0.67(0.66–0.80). Chelicera 0.245(0.23–0.29) long. Palpal femur 0.555(0.525–0.66) by 0.16(0.155–0.205); tibia 0.465(0.46–0.58) by 0.215(0.205–0.25); chela (with-

out pedicel) 0.94(0.91–1.12) by 0.295(0.29–0.38); hand (without pedicel) 0.49(0.48–0.63) by 0.295(0.28–0.38); pedicel about 0.07 long; movable finger 0.48(0.46–0.54) long. Leg I: basifemur 0.26(0.25–0.28) by 0.105(0.105–0.12); telofemur 0.155(0.155–0.17) by 0.11(0.10–0.11). Leg IV: entire femur 0.555(0.53–0.66) by 0.205(0.20–0.325); tibia 0.40(0.385–0.41) by 0.115(0.115–0.125).

Etymology.—The new species is named for Kenneth W. Cooper, who collected most of the specimens, along with many other pseudoscorpions in southern California.

Remarks.—Heretofore, 2 species of the genus *Pseudogarypinus* have been recognized in the United States, *P. frontalis* (Banks) widely distributed in the western states from New Mexico to Washington, and *P. giganteus* Hoff from only a single locality in Colorado (see Benedict and Malcolm, 1977). The new species, known at present from a restricted area in southern California, is easily distinguished from the others by its small size. In addition, it differs in having fewer setae on the tergites and sternites and on the spiracular plates, in having fewer teeth on the chelal fingers, and in the length and placement of the rami on the galea.

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Literature Cited

- Benedict, E. M., and D. R. Malcolm. 1977. Some garypoid false scorpions from western North America. (Pseudoscorpionida: Garypidae and Olpiidae). *J. Arachnol.*, 5:113–132.
- Chamberlin, J. C. 1923. New and little known pseudoscorpions, principally from the islands and adjacent shores of the Gulf of California. *Proc. California Acad. Sci.*, 12:353–387.
- Chamberlin, J. C. 1930. A synoptic classification of the false scorpions or chela-spinners, with a report on a cosmopolitan collection of the same.—Part II. The Diplosphyronida (Arachnida—Chelonethida). *Ann. Mag. Nat. Hist.*, (Ser. 10), 5:585–620.
- Chamberlin, J. C. 1931. The arachnid order Chelonethida. *Stanford Univ. Publ. Biol. Sci.*, 7, No. 1:1–284.
- Hoff, C. C. 1956. Diplosphyronid pseudoscorpions from New Mexico. *Amer. Mus. Novitates*, 1780:1–49.
- Hoff, C. C. 1959. The ecology and distribution of the pseudoscorpions of north-central New Mexico. *Univ. New Mex. Publ. Biol.*, No. 8:1–68.
- Hoff, C. C. 1961. Pseudoscorpions from Colorado. *Bull. Amer. Mus. Nat. Hist.*, 122:409–464.
- Hoff, C. C. 1964. The pseudoscorpions of Jamaica. Part 3. The suborder Diplosphyronida. *Bull. Inst. Jamaica, Sci. Ser. No. 10*, Pt. 3:1–47.
- Muchmore, W. B. 1979. Pseudoscorpions from Florida and the Caribbean area. 7. Floridian diplosphyronids. *Florida Entomol.*, 62:193–213.

NOMENCLATORIAL NOTES ON NORTH AMERICAN
CYNIPIDAE (HYMENOPTERA)

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The following notes are based primarily on studies of type material in the Collection of the U.S. National Museum of Natural History (USNM), but specimens in the California Insect Survey (CIS) and the California Academy of Sciences (CAS) have also been examined. Much of the information presented here was derived from curatorial work on the USNM cynipoid collection by Dailey during 1977 which was funded by USDA cooperative agreement No. 12-14-1001-1191.

This paper is one of several types of studies needed to achieve a good systematic understanding of the Cynipidae. Associating morphologically dissimilar bisexual and unisexual generations of heterogenous species by controlled rearing of both adults and galls is perhaps the most essential type of study. Clear definition of genera, the most pressing problem in the Cynipidae, is directly dependent upon such investigations. Currently, it is difficult to assess generic limits (i.e. which morphological features are significant at the generic level) because most species are known from only one generation. Species placed in different genera may be found to be alternating generations of one species in controlled rearing studies. For example, *Dryocosmus grumatus* Weld, 1952, proved to be the unisexual generation of *Callirhytis serricornis* (Kinsey), 1922; and *Liodora dumosae* Weld, 1957, proved to be the bisexual generation of *Andricus pattersonae* Fullaway, 1911. Another problem is identifying adults of species described only from galls. At one time many workers regarded names based only on galls as nomina nuda, and subsequently these species names have tended to be ignored. This relates directly to another area in need of attention in the Cynipoidea: Type studies and nomenclature. The many varietal names in the literature compound this problem area. A final problem is that some of the morphological terminology in the Cynipoidea is outdated. Weld used terms which are sometimes ambiguous or not particularly descriptive, and

subsequent workers have tended to perpetuate them. "Weldian terminology" needs to be scrutinized carefully in light of modern morphological usage in the Hymenoptera.

We would like to thank Eric Grissell, Systematic Entomology Laboratory, USDA and Richard Rust, University of Nevada, Reno, for their constructive criticisms.

Xanthoteras clavuloides (Kinsey), **NEW COMBINATION**

Dryophanta clavula Beutenmüller, 1911a:67, ♀, gall. Lectotype ♀, Sonoma Co., Calif. (USNM), present designation. Preoccupied in *Cynips* by *clavula* Osten Sacken, 1865.

Cynips teres var. *clavuloides* Kinsey, 1930:215. New name for *Cynips clavula* (Beutenmüller).

Weld (1951) placed this unisexual species in *Antron*, but because *clavuloides* has a malar groove, it keys to the bisexual generation of *Xanthoteras* in Weld's (1957) generic key to western U.S. cynipids. The absence of a malar groove in *Antron* is a major separation feature from *Xanthoteras* in this key, at least for the bisexual generation. Weld obviously recognized the proper generic assignment of *clavuloides* because it is in his unpublished ms. key to the species of *Xanthoteras* (under the name *clavula*).

The separation of *Xanthoteras* from *Antron* on the basis of the malar groove may work for the bisexual generation, but it is not entirely satisfactory for unisexual forms. *Xanthoteras teres* Weld, a unisexual, micropterous species, does not have a malar groove, but it seems closely related to *X. clavuloides*, a macropterous species, on the basis of a bristly ventral abdominal spine, and similar brown, club-shaped galls. Clearly the generic limits of *Antron* and *Xanthoteras* are in need of study.

Although homonymy between Beutenmüller's and Osten Sacken's species no longer exists, Kinsey's name *clavuloides* must be used under the provisions of Art. 59 of the Code. Beutenmüller described *clavula* from galls and "twelve specimens from Napa and Sonoma Counties." There are 59 adults in the USNM labeled Sonoma Co., 11 of which bear "type" or "cotype" labels. We have chosen the best of the "type" specimens as the lectotype. There is no material labeled Napa County.

Xanthoteras pulchellum (Beutenmüller)

Dryophanta pulchella Beutenmüller, 1911b:357, ♀. Lectotype ♀, Santa Catalina Island, California (USNM), present designation.

Trigonaspis obconica Weld, 1921:202, ♂, ♀, gall. Holotype ♀, Los Gatos, California (USNM). **NEW SYNONYMY.**

In 1930 Weld noted this synonymy on a determination label on material in the USNM, and later in his manuscript key to the species of *Xanthoteras*, but it has never been published. Our examination of the types confirms the synonymy.

Beutenmüller described *pulchella* from two females, one from Santa Catalina Island, and one from Hood River, Oregon, both in the USNM. We have selected the California specimen as lectotype.

Andricus quercusfrondosus (Bassett), **NEW STATUS**

Cynips q. frondosa Bassett, 1865:688, gall. Lectotype gall (USNM), present designation.

Andricus flavohirtus Beutenmüller, 1913:124, ♀, gall. Holotype ♀, Fort Lee, New Jersey (USNM).

The synonymy of these two names was noted by Weld (1959:42) who continued to use Beutenmüller's name for the species, probably because he regarded Bassett's name, based solely on the gall, as a nomen nudum. However, Bassett's name is available (Art. 24 b (iii)). The synonymy was not included in the second supplement to the Hymenoptera Catalog (Weld, 1967).

Although much of Bassett's collection is housed in the Academy of Natural Sciences of Philadelphia, part or all of his type galls of *quercusfrondosa* are in the USNM. Bassett did not give a locality for his species nor is one indicated with the galls, but presumably they originated in Connecticut. Comparison of Bassett's galls with those of *flavohirtus* Beutenmüller shows that Weld's synonymy is correct. We have selected one of Bassett's galls as lectotype.

Bassett's original description is usually cited as 1864, but a footnote on pages 684–685 is dated Jan. 28, 1865. Thus the latter year is the correct date for *quercusfrondosus*.

Andricus truckeensis (Ashmead), **NEW COMBINATION**

Holcaspis truckeensis Ashmead, 1896:127, ♀, gall. Lectotype ♀, Truckee, Calif. (USNM), present designation.

Disholcaspis truckeensis (Ashmead), Weld, 1951:640.

The notauli are complete in *truckeensis* which indicates that this species is more properly placed in *Andricus* than *Disholcaspis*, the latter genus being its most recent assignment. *Andricus truckeensis* is similar to three other species in the genus which have a pubescent thorax, a blunt† mostly ovipositor spine, and which occur on oaks of the subgenus *Protobalanus*: *lasius* (Ashmead), *reniformis* McCracken & Egbert, and *spectabilis* Kinsey (see generic key in Weld, 1957). McCracken & Egbert (1922) suggested that

reniformis might be only a variety of *truckeensis*. Additional studies may indicate that these four species should be placed in a new genus.

Both of Ashmead's females of *truckeensis* are labeled "type" and bear USNM type #3080; consequently we regard them as syntypes and have selected one as lectotype.

The type galls of *truckeensis* bear the rearing number 3769 which indicates that they were sent to Ashmead by Koebele in 1885. They cannot be the galls from which the two adults were reared because the wasps have labels dated 1880. Furthermore, according to Ashmead his two females were reared from galls sent by Comstock (rearing #731). The Koebele galls appear to belong to another western species, *A. reniformis* McCracken & Egbert. Also in the USNM collection there are larger, more ovoid, smooth contoured, tan galls from *Quercus chrysolepis* Leibm. collected by Weld at Kyburz and Idyllwild, California, inside of which he found wasps identical with Ashmead's adults of *truckeensis*. Weld (1957, fig. 80) figured this gall.

Status of *Liodora dumosae* Weld, 1957, and *Andricus kingi* Bassett, 1900

After some rearing experiments which yielded bisexual adults from galls identified as *Liodora dumosae*, Rosenthal and Koehler (1971) reached the conclusion that *dumosae* and *Andricus kingi* Bassett, 1900, were the alternate generations of a single species. Dailey has examined the material of Rosenthal and Koehler's study (CIS) and found that they misidentified their wasp. The specimens are not *dumosae*, but are the previously unknown bisexual generation of *kingi*. The complete scutal notauli and short, straight tip of the galls distinguish the sexual form of *kingi* from that of *dumosae*.

Evans' (1972) rearing studies indicated that *Liodora dumosae* and *Andricus pattersonae* Fullaway, 1911, were the alternate generations of one species. He transferred *pattersonae* to the genus *Liodora*. Some of Evans' paratypes (CAS) have been compared with Weld's paratypes (USNM), and they are the same species.

Callirhytis quercusmedullae (Ashmead)

Cynips q. medullae Ashmead, 1885:viii, ♀, gall. Lectotype ♀, Jacksonville, Florida (USNM), present designation.

Andricus cryptus Ashmead, 1887:145 ♀, gall. Lectotype ♀, Jacksonville, Florida (USNM), present designation. **NEW SYNONYMY.**

Weld noted this synonymy in his unpublished manuscript key to the species of *Callirhytis*, but it has not been established in print. We have examined the types of both species and confirm Weld's synonymy. Two of Ashmead's four syntypes of *quercusmedullae* and one of his two syntypes of *crypta* are extant in the USNM. Lectotype labels have been applied to one of the former and the single specimen of the latter.

The conspicuously swollen twigs from which the types of *quercusmedullae* emerged are quite different from the slender twig which produced the types of *crypta* (see figures 134 and 162 in Weld, 1959). This difference may have been caused by the presence of the inquiline, *Synergus medullae* Ashmead, in the galls of *C. quercusmedullae*. It is known that inquilines can cause modification of the host gall, as happens for example in galls of the bisexual generation of an undescribed Californian species of *Callirhytis* inhabited by *Synergus digressus* McCracken & Egbert.

Literature Cited

- Ashmead, W. H. 1885. On the cynipidous galls of Florida with descriptions of new species. Trans. Amer. Entomol. Soc., Proc., 12:v-ix.
- Ashmead, W. H. 1887. On the cynipidous galls of Florida, with descriptions of new species and synopses of the described species of North America. Trans. Amer. Entomol. Soc., 14:125-158.
- Ashmead, W. H. 1896. Descriptions of new cynipidous galls and gall-wasps in the United States National Museum. Proc. U.S. Natl. Mus., 29:113-136.
- Bassett, H. F., 1865. Descriptions of several new species of *Cynips*, and a new species of *Diastrophus*. Proc. Entomol. Soc. Philadelphia, 3:679-691. (dated 1864, but published 1865).
- Beutenmüller, W. 1911a. Descriptions of new species of Cynipidae. Entomol. News, 22:67-70.
- Beutenmüller, W. 1911b. Description of a new *Dryophanta*. Entomol. News, 22:357.
- Beutenmüller, W. 1913. A new *Andricus* from New Jersey. Insecutor Inscitiae Menstruus, 1:124-125.
- Evans, D. 1972. Alternate generations of gall cynipids on Garry Oak. Canadian Entomol., 104:1805-1818.
- Kinsey, A. C. 1930. The gall wasp genus *Cynips*. Indiana Univ. Stud., 16:1-577.
- McCracken, L., and D. Egbert. 1922. California gall-making Cynipidae with descriptions of new species. Stanford Univ. Publ., Biol. Sci., 3(1):1-70.
- Rosenthal, S. S., and C. S. Koehler. 1971. Heterogony in some gall-forming Cynipidae with notes on the biology of *Neuroterus saltatorius*. Ann. Entomol. Soc. America, 64:565-570.
- Weld, L. E. 1921. American gallflies of the family Cynipidae producing subterranean galls on oak. Proc. U.S. Natl. Mus., 59:187-246.
- Weld, L. E. 1951. Superfamily Cynipoidea, pp. 594-654 in: Muesebeck, C. F. W. et al., Hymenoptera of America north of Mexico, synoptic catalog. U.S. Dept. Agric., Agric. Monog. 2, 1420 pp.
- Weld, L. E. 1957. Cynipid galls of the Pacific Slope. Ann. Arbor, Michigan. Privately published, 124 pp.
- Weld, L. E. 1967. Superfamily Cynipoidea, pp. 282-284 in: Krombein, K. V. and B. D. Burks, Hymenoptera of America north of Mexico, synoptic catalog, second supplement. U.S. Dept. Agric. Agric. Monog. 2, 584 pp.

Footnote

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**A NEW SPECIES OF *ACMAEODERA*
(COLEOPTERA: BUPRESTIDAE)¹**

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The type series of *Acmaeodera discalis* Cazier (1940) included the holotype male from Arizona, Gila Co., Pinal Mts. [AMNH] and 2 female paratypes from Texas, El Paso. More material has been collected from Arizona, Texas, and Coahuila, and the female genitalia reveal 2 distinctively different forms. The population from Texas and Coahuila, including the 2 female paratypes of *A. discalis*, is described as a new species.

Abbreviations for collections [brackets] are as listed by Arnett and Samuelson (1969) except for the collections of W. F. Barr = WFBC and D. S. Verity = DSVC. Appreciation is extended to W. F. Barr, Univ. of Idaho, R. L. Westcott, Oregon Dept. of Agric., Salem, and to the publications committee of the Division of Plant Industry, Florida Dept. of Agric. and Consumer Services, for helpful comments on the manuscript; and to the following for the loan of specimens: W. F. Barr; F. M. Beer, Corvallis, Ore.; Lee H. Herman, AMNH; E. H. Smith, FMNH; J. W. Tilden, San Jose, Calif.; D. S. Verity and G. C. Walters, Los Angeles, Calif.; and R. L. Westcott.

***Acmaeodera riograndei*, new species
(Figs. 2, 4)**

Diagnosis.—Medium size, robust; pronotum and ventral body unicolorous aeneo-black; elytral disk yellow, cupreo-black or piceous along base, lateral and sutural margins and usually as small markings arranged longitudinally in middle of disk; prosternum with anterior margin slightly, arcuately retracted; apical abdominal sternite without subapical carina; terminal segment of female genitalia about as broad as long, less than 0.25 the length of elytra.

Description, female holotype, Fig. 2.—Head with front feebly convex; densely shallowly punctate and clothed with semierect white setae; clypeus shallowly emarginate; antennae extending to just beyond middle of pronotum, serrate from segment 5. Pronotum as wide as elytra, 1.9 times as wide as long; laterally bluntly angulate at basal third, converging obliquely to base and apex, constricted subapically; basal margin nearly straight, converging slightly forward; apical margin bisinuate with depressed border;

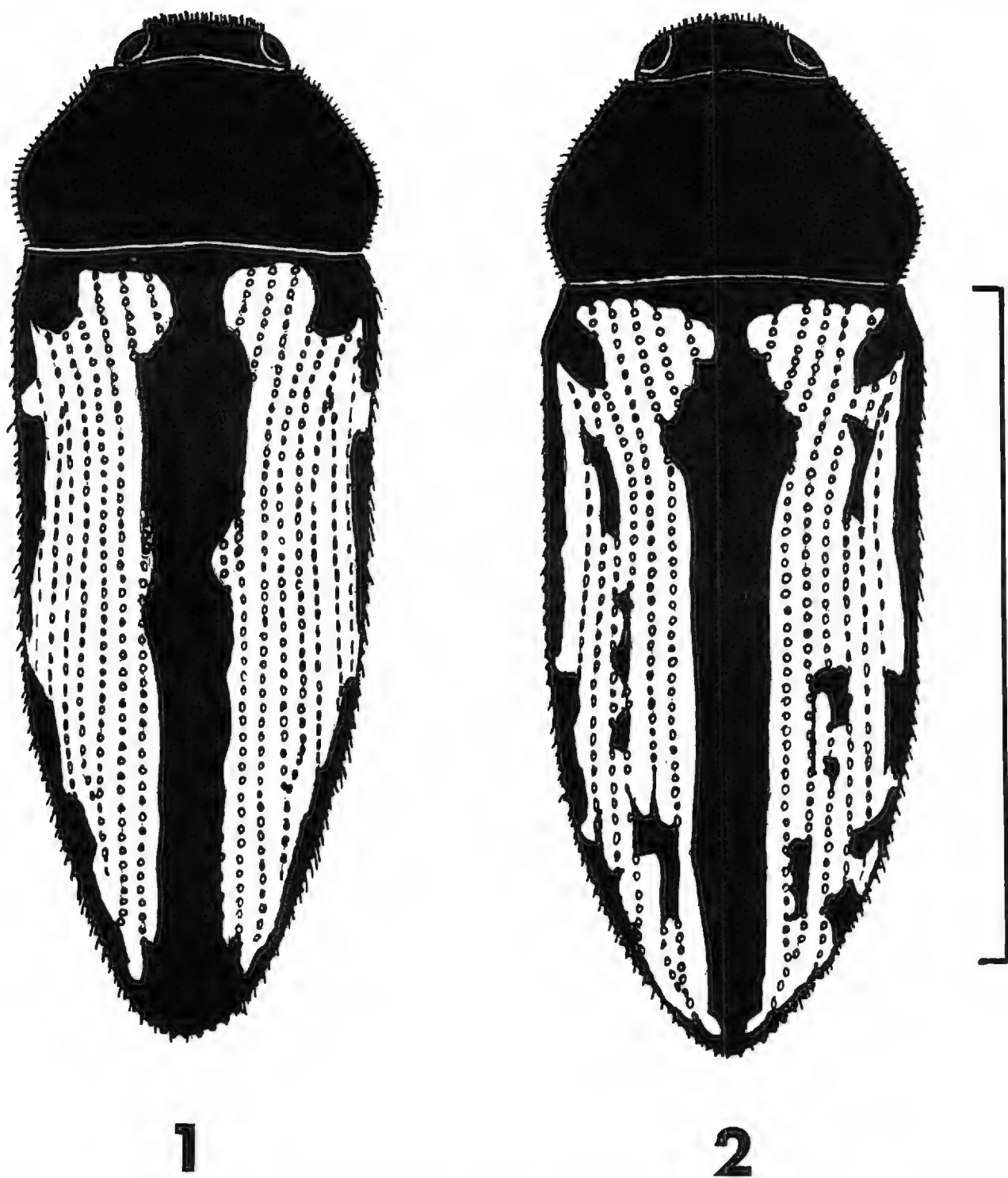


FIG. 1. *Acmaeodera discalis* Cazier, female plesiallotype. Fig. 2. *Acmaeodera riograndei* Nelson, new species, female holotype (line = 5 mm for Figs. 1 and 2).

surface convex, with feeble midline impression more evident basally and apically and with small deep fovea near base toward lateral angles; disk deeply, densely punctate, punctures denser toward margins; surface moderately clothed with short semierect white setae. Elytra with lateral margins diverging for short distance from base, then subparallel to middle and roundly converging to blunt apex; margins serrate in apical 0.66; strial punctures deep and moderately large; each interstrial space with single row of setal-

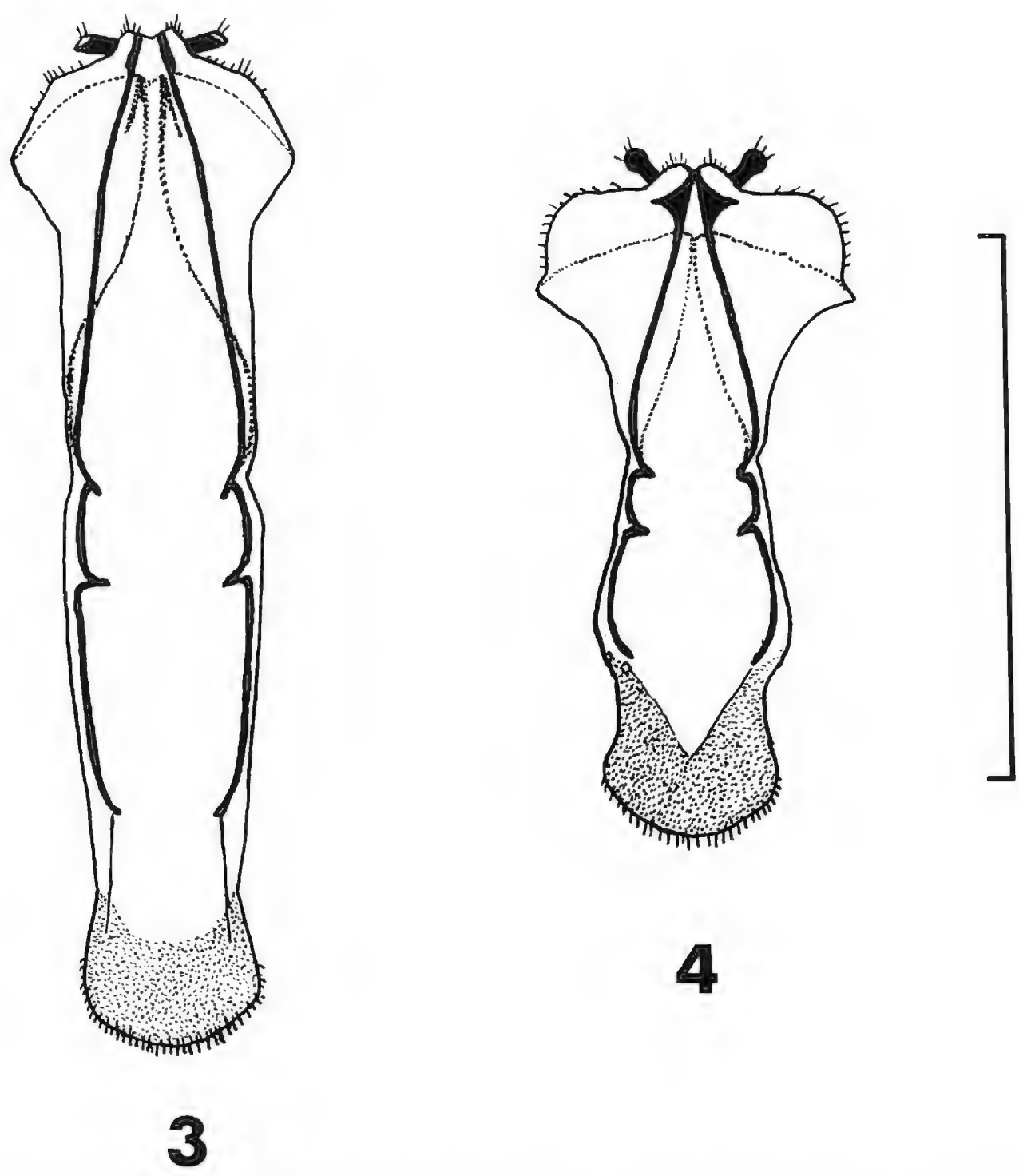


Fig. 3. *A. discalis*, female genitalia. Fig. 4. *A. riograndei*, female genitalia (line = 2 mm for Figs. 3 and 4).

bearing punctures. Beneath, densely punctate, with semirecumbent white setae.

Genitalia, Fig. 4, with membranous apical segment (coxite, according to Tanner, 1927) almost as wide as long, elytra more than 4 times as long as coxite.

Length 7.7 mm; width 2.8 mm. .
Male, allotype.—Similar to female, but differs as follows: slightly less

robust; dark markings on disk of elytra less extensive, extending from base only 0.4 distance to apex; antennae slightly longer, with segments larger.

Length 6.5 mm; width 2.4 mm.

Type material.—Holotype [USNM 75754], Texas, Brewster Co., Big Bend National Park, W side of Chisos Mts., Oak Springs, 24 June 1971, G. H. Nelson, on *Cirsium* sp. blossom; allotype [USNM] and 6 female paratypes, type locality, 25 June 1971, G. H. Nelson, on *Cirsium* sp. blossoms.

Other paratypes.—8 females, 6 males, same data as holotype; 1 female, 3 males, same data except 1 July 1963; 1 female, same data except 20 June 1965; 4 females, 1 male, type locality, 30 June 1963, and 1 male, 1 July 1963, F. M. Beer, *Cirsium* sp. blossoms; 1 female, Big Bend National Park, 5 km E of Panther Junction, 26 June 1963, G. H. Nelson and family, on yellow composite blossom; 1 female, Big Bend National Park, Castolon, 18 July 1967, J. W. Tilden; 1 female, 1 male, Big Bend National Park, Basin, 15 June 1948, M. Cazier; 2 males, same place, 14 June 1948, M. Cazier; 1 male, same park, 9.7–14.5 km E of Panther Junction, 1 July 1972, R. L. Westcott; 1 female, 22.6 km W of Panther Junction, 5 July 1961, P. D. Christenson; 2 females, Texas, El Paso (part of type series of *A. discalis*). Mexico, Coahuila: 1 female, 1 male, Guadalupe, 24 May 1952, M. Cazier, W. Gertsch, R. Schrammel; 1 female, Paila, 1156 m, 21 August 1947, Spieth; 5 females, 1 male, LaRosa, 1603 m, 22 August 1947, Spieth, Gertsch, Michener. Paratypes are in the following collections: AMNH, CASC, FMNH, FSCA, WFBC, RLWE, DSVC, FMBC, GCWC, GHNC, JWTC.

Variation.—There is considerable variability in the extent of the dark markings on the yellow elytral discal area in *A. riograndei*. The females are generally more heavily maculated with dark discal spots, 32 with and 2 with none. Of the males, 9 have discernible discal maculations and 9 do not. Females vary from 6.5 to 7.8 mm long and 2.3 to 3.0 mm wide; males from 6.0 to 6.8 mm long and 2.0 to 2.7 mm wide.

Biology.—Larval habits are unknown, and adult habits are included under type material.

Comparison.—This species belongs in the truncate group and will key to *Acmaeodera quadrivittata* Horn in Fall (1899). It can be separated from *A. quadrivittata* by its larger size, and the pronotum which has more angulate side margins and is more densely punctate. *A. riograndei* is superficially similar to *Acmaeodera discalis* Cazier but differs as follows: body usually more robust with elytra more blunt apically and yellow discal area with dark markings arranged longitudinally from humeral unbone toward apex (dark discal markings present in only 9 of 32 *A. discalis* examined); female genitalia with coxite about as broad as long in *A. riograndei* but more than 1.5 times as long as broad in *A. discalis*. On the basis of the female genitalia,

A. riograndei appears more closely related to *A. quadrivittata* than to *A. discalis* in spite of the close superficial resemblance to the latter.

Acmaeodera discalis Cazier
(Figs. 1, 3)

The original diagnosis and description (Cazier, 1940) refer to the holotype male only, so the male will not be redescribed. Since the 2 original female paratypes belong to *A. riograndei*, female characteristics of *A. discalis* will be redefined.

Description, female plesiallotype.—Differs from male as follows: antennae shorter, reaching 0.66 the distance to hind angles of pronotum; genitalia with coxite more than 1.5 times as long as wide and more than 0.25 the length of elytra.

Length 7.4 mm; width 2.7 mm.

Plesiallotype [GHNC] from Arizona, Pinal Mts., top of Sixshooter Canyon, elev. 2286 m, 30 August 1959, G. H. Nelson, on lavender composite.

Variation.—Of the 32 *A. discalis* examined, only 9 had any dark discal markings on elytra. They varied in size from 6.4 to 9.0 mm long and 2.3 to 3.3 mm wide.

Geographical distribution.—Central and southeastern Arizona. Type locality: Gila Co., Pinal Mts. Other localities in Arizona, from which material has been seen, include: Coconino Co., Oak Creek Canyon, 1–18 August, D. J. & J. N. Knull [FMNH]; Gila Co., Payson, September 1962 [GHNC]; Pima Co., Santa Catalina Mts., Molino Basin, 20 August 1953, G. M. Bradt [WFBC]; same place, 23 August 1952, G. M. Bradt [AMNH]; Santa Catalina Mts., Sabino Canyon, 6 September 1964, G. C. Walters; Pima Co., Rincon Mt., 16 September 1937, E. D. Ball [WFBC]; Cochise Co., Huachuca Mts., Miller's Canyon, 12 August 1961, GHN, on rock [GHNC]; Huachuca Mts., 24 July to 9 September, D. J. & J. N. Knull [FMNH]; Cochise Co., Palmerly [Palmerlee], June [AMNH]; Sixshooter Canyon, near Globe, 17 August 1958, R. L. Westcott [RLWE].

Biology.—The larval habits are unknown, and scant data on adults indicate they have been taken alighting on rocks and on lavender composites.

Comparison.—The superficial resemblance to *A. riograndei* is discussed under that species. On the basis of the female genitalia, *A. discalis* is most closely related to *Acmaeodera cazieri* Knull. The latter is similar in size and form but can be readily separated from *A. discalis* as follows: pronotum and ventral body black with bluish tint, and light color on elytra reduced to vittae.

Literature Cited

- Arnett, R. H., Jr., and G. A. Samuelson (eds.). 1969. Directory of Coleoptera collections of North America (Canada through Panama). Purdue Univ., Lafayette, Indiana, 123 pp.
- Cazier, M. A. 1940. New North American *Acmaeodera*, with synonymical and miscellaneous notes on other species (Coleoptera:Buprestidae). The Wasmann Collector, 4(1):17-29.
- Fall, H. C. 1899. Synopsis of the species of *Acmaeodera* of America, north of Mexico. J. N.Y. Entomol. Soc., 7(1):1-37.
- Tanner, V. M. 1927. A preliminary study of the genitalia of female Coleoptera. Trans. Amer. Entomol. Soc., 53:5-50.

Footnotes

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ZOOLOGICAL NOMENCLATURE

AN(S) 112

25th February, 1980

The Commission hereby gives six months notice of the possible use of its plenary powers in the following cases, published in *Bull. Zool. Nom.* Volume 36, part 4, on 18th February 1980, and would welcome comments and advice on them from interested zoologists. Correspondence should be addressed to the Secretary, if possible within six months of the date of publication of this notice.

1237 *Carabus caerulescens* Linnaeus, 1758, *C. cupreus* Linnaeus, 1758, and *Cicindela rupestris* Linnaeus, 1767 (Insecta, Coleoptera): designation of type specimens.

2219 *Ceutorhynchus* Germar, 1824 and *Rhinoncus* Schönherr, 1826 (Insecta, Coleoptera): proposed conservation and designation of type species.

2294 *Bellota* Peckham & Peckham, 1892 (Araneae): proposed designation of type species.

R. V. Melville, *Secretary*

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London, SW7 5BD, United Kingdom

EMERGENCE, MATURATION AND PARASITES OF TWO ASH
BARK BEETLES, *LEPERISINUS OREGONUS* BLACKMAN
AND *L. CALIFORNICUS* SWAINE
(COLEOPTERA: SCOLYTIDAE)

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This study was part of a larger study of the sonically and olfactorily induced behavior of *Leperisinus oregonus* Blackman and *L. californicus* Swaine (Vernoff and Rudinsky, 1980; Rudinsky and Vernoff, 1979). Wood (1977) has proposed that this genus be placed in synonymy under *Hylesinus* Fabricius.

Methods

Observations were made by allowing *L. oregonus* and *L. californicus* to colonize a 24 cm DBH log of *Fraxinus latifolia* Benth., felled 22 April 1975, in an ash woodlot near Corvallis, Oregon. Colonization was mainly by *L. oregonus* in May-June. On 11 August 1975, this tree was bucked (cut) into 36 sections, each 34-37 cm long, numbered with respect to distance from the base, transferred to a shaded part of the Forest Insect Laboratory nursery, and placed inside 38 cm³ galvanized metal emergence boxes. There were 1-4 logs per box. *Leperisinus* adults emerged into the glass light jar on each box and were collected between 14 August and 19 October 1975. Collections were made daily between 31 August and 1 October, and hourly from some boxes on 9-11 September 1975. In September 1976, the length, basal DIB and apical DIB were measured for each log, before it was debarked and the number of galleries counted. Daily temperature data were obtained from the Natl. Weather Service (NOAA) at Oregon State University.

Results

1. Emergence

Between 11 Aug. and 7 Oct. 1975, when emergence was nearly over, 6988 *Leperisinus* adults emerged from 1800 galleries in the 6.38 m² surface area between the base and a point 12.71 m beyond the base, which was 11 cm diam. There were 5659 *L. oregonus* ($\delta\delta/\eta\eta = 1.04$) and 1329 *L. californicus* ($\delta\delta/\eta\eta = 0.96$). Sex ratios were 1:1. Attack density, in galleries per m², was relatively constant along the bole length ($R^2 = .213$). Brood pro-

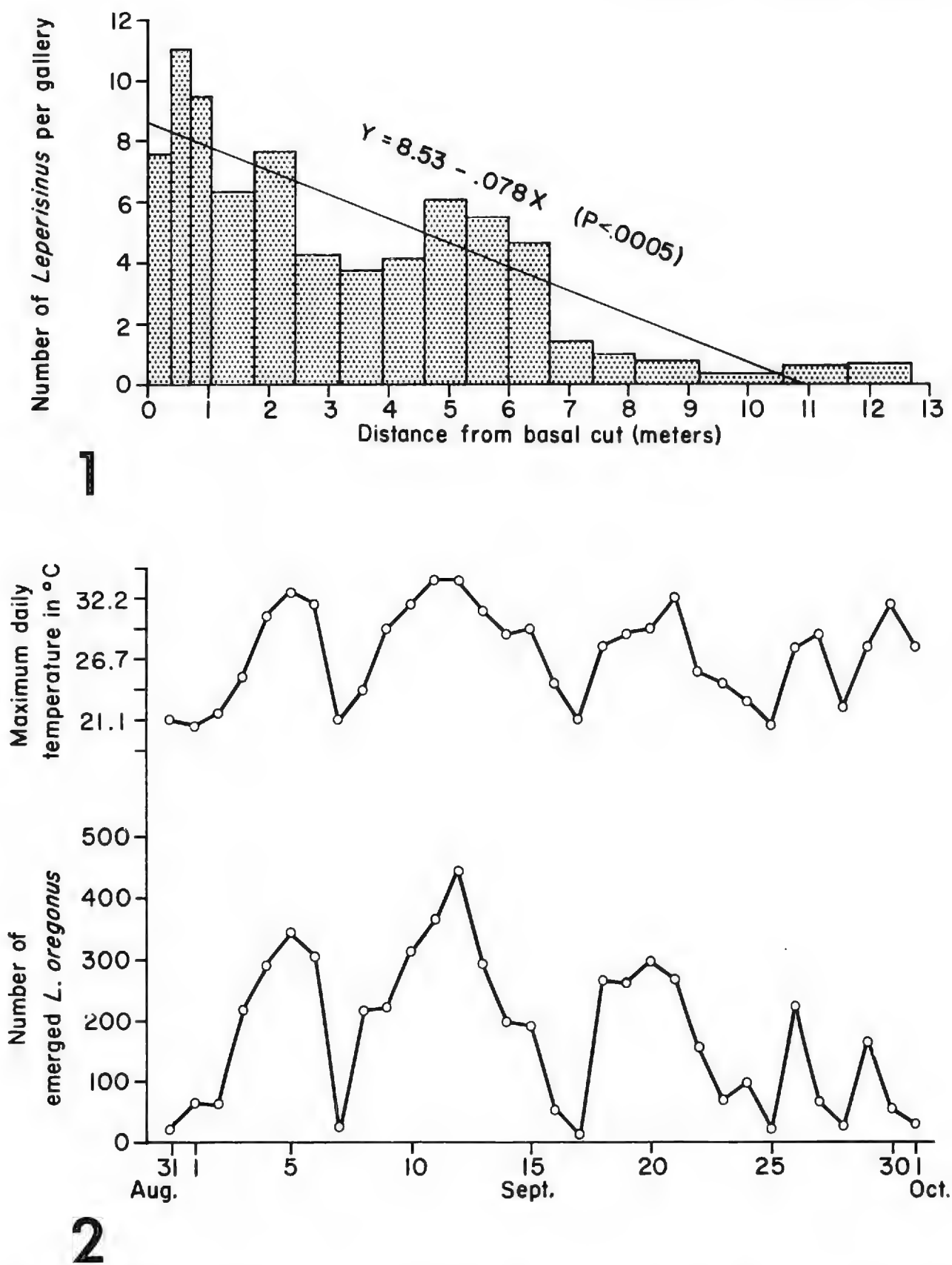


Fig. 1. Combined emergence of *Leperisinus oregonus* and *L. californicus* along the length of one felled *Fraxinus latifolia* between 11 August and 7 October 1975. Fig. 2. Hot spells accompanied by waves of *L. oregonus* emergence between 31 August and 1 October 1975.

duction and/or survival decreased significantly from the base to the apex, as measured by beetles per gallery ($R^2 = .789$; Fig. 1) or beetles per m^2 ($R^2 = .647$, no. of *Leperisinus* per $m^2 = 2145-187$ [distance from basal cut in m]). Basal logs had long galleries with many egg niches and larval mines,

whereas apical logs had short galleries with few niches and mines. This may be due to two factors: basal logs were protected from sunlight by moss growth and by shade from an overhanging bush, and their thicker bark probably retarded dessication and parasite oviposition. Large numbers of the braconid, *Coeloides scolytivorus* (Cresson), emerged mainly from apical sections in August–September 1975 and especially June 1976.

The 32-day period from 31 August through 1 October 1975 was rainless and included five hot spells (Fig. 2, upper curve) during which *L. oregonus* emergence fluctuated correspondingly (Fig. 2, lower curve). Daily emergence increased significantly with maximum daily temperature ($R^2 = .645$, no. of *L. oregonus* = $-454 + 23.2$ (daily °C)). Emergence was low before noon and highest between 2–4 p.m. DST.

2. Maturation

Internal reproductive organs of both *L. californicus* and *L. oregonus* were like those of *L. fraxini* (Jamnický, 1961) in number and arrangement. Adults of both species were sexually immature upon emergence from brood logs. Females had small germaria, little or no follicle differentiation, and small colleterial glands. Males had tiny seminal vesicles, thin accessory glands, but moderate size testes. Adults attracted to cages containing naturally infested logs during colonization or excised from breeding galleries were mature. In females, colleterial glands were enlarged, and each ovariole had a swollen germarium, a thin elongated area, and 2–5 distinctly enlarged eggs. In males, seminal vesicles and accessory glands were enlarged, and testes sometimes appeared fused. Senescent *L. californicus* had enlarged but stiff reproductive systems containing air bubbles and/or congealed material.

Eight *L. californicus* of either sex were found in individual feeding burrows in living trees (during Feb., Mar., Apr., July and Aug.). Some were partly mature, but others were fully mature or senescent so may have been reemerged parents. Their burrows were in twig crotches, nodes, buds, or leaf axils. Abandoned burrows were common.

3. Hymenopterous Parasites

In the field during August 1975, the following parasite species landed on cages containing logs naturally infested with *L. californicus*: *Spathius benefactor* Matthews (Braconidae) females, *Cheiopachus quadrum* (Fabricius) (Pteromalidae), and a few *Harmolita* sp. (Eurytomidae). In the field during July 1978, *Coeloides scolytivorus* (Cresson) (Braconidae) landed on cages containing logs experimentally infested with *L. californicus* pairs.

The following parasites emerged from brood logs colonized mainly by *L. oregonus*: *C. scolytivorus* (males predominant), *S. benefactor* (females predominant), *C. quadrum*, *Habroclytus* sp. (Pteromalidae) and a few *Eurytoma*

sp. (Eurytomidae). The following parasites emerged from brood logs colonized mainly by *L. californicus*: *C. scolytivorus*, *S. benefactor*, and *Habrocytus* sp.

C. quadrum and one *C. scolytivorus* were laboratory-reared from immatures collected in January 1975 from abandoned *Leperisinus* gallery systems in tops of a tree felled spring 1974.

It is not known which species are primary parasites and which may be hyper-parasites. *C. scolytivorus* has been reported as a primary parasite of another North American *Leperisinus*, *L. aculeatus* (Say) (Hoffmann, 1938; Beal and Massey, 1945).

Acknowledgments

I would like to thank Dr. Julius A. Rudinsky for providing facilities for the research, Dr. M. T. AliNiazee for reviewing the manuscript, Dr. Paul M. Marsh for identifying the Braconidae, and Dr. E. Grissell for identifying the Chalcidoidea. Funds were provided by an NSF graduate fellowship. From a Master's thesis submitted to Oregon State University.

Literature Cited

- Beal, J. A., and C. L. Massey. 1945. Bark beetles and ambrosia beetles (Coleoptera: Scolytoidea) with special reference to species occurring in North Carolina. Duke Univ. School of Forestry Bull. 10.
- Hoffmann, C. H. 1938. Notes on *Leperisinus aculeatus* (Say) and its parasites (Coleoptera, Scolytidae). J. Econ. Entomol., 31:118–119.
- Jamnický, J. 1961. Rojenie kôrovca *Leperisinus fraxini* Panz. Biológia (Bratislava), 16:264–273.
- Rudinsky, J. A., and S. Vernoff. 1979[1980]. Evidence of a female-produced aggregative pheromone in *Leperisinus californicus* Swaine (Coleoptera: Scolytidae). Pan-Pacific Entomol., 55:299–303.
- Vernoff, S., and J. A. Rudinsky. 1980. Sound production and pairing behavior of *Leperisinus californicus* Swaine and *L. oregonus* Blackman (Coleoptera: Scolytidae) attacking Oregon ash. Z. ang. Ent., in press.
- Wood, S. L. 1977. New synonymy and new species of American bark beetles (Coleoptera: Scolytidae), Part VI. Great Basin Naturalist, 37:511–522.

Footnote

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A NEW SPECIES OF *MYSTACAGENIA* FROM PANAMA
(HYMENOPTERA, POMPILIDAE)

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The species of *Mystacagenia* appear to be very rare insects; only four specimens, all females, have been reported to this date (Evans, 1973, 1977). The major distinguishing feature of the genus is the prominent brush of pale setae on the exterior face of the mandibles. The known species have strongly banded wings and a remarkably complex color pattern which differs considerably among the species. I can suggest no function for these elaborate patterns unless they are disruptive and render the insects inconspicuous in the patchy light of forests.

The discovery of a species in Panama represents a considerable range extension for the genus, the three previously known species being known from Brazil and Peru. The new species appears closest to *M. bellula* Evans but differs in the shape of the clypeus and in many details of coloration.

***Mystacagenia elegantula*, new species**

Holotype.—♀, Barro Colorado Island, Canal Zone, Panamá, 13 Sept. 1978 (L. S. Kimsey) [Univ. Calif. Davis].

Description.—Length 5.0 mm; forewing 4.1 mm. Head largely pale orange-brown, except whitish on posterior orbits, clypeus, and face below antennal sockets; head with brown spots at middle inner orbits, sides of clypeus, and sides of occiput; mouthparts, including mandibular brushes, whitish; thorax orange-brown, blotched with fuscous on sides of scutellum, all of metanotum, and anterior third of propodeum, also along pleural sutures and on venter; abdomen fuscous except basal segment dark orange-brown, remaining segments suffused with dark ferruginous along posterior margins and apical segment mostly of this color. First two antennal segments orange-brown, weakly infuscated laterally; remainder of antenna fuscous laterally, whitish mesally, except apical third orange-brown, extreme tip fuscous. Legs variegated; front and hind coxae whitish, middle coxae partially infuscated; front femora light brown, streaked with darker brown; middle and hind femora fuscous but streaked with white apically on upper surface; tibiae moderately infuscated, front and middle tibiae with three white spots on outer surface, hind tibiae with two such spots; tarsi largely

brownish, basal segments darker than the remainder. Wings with a faint yellowish tinge, hindwing unbanded, forewing with a narrow dark band over the basal and transverse median veins, well separated from a broader band below the stigma, which is dark brown. Clypeus with several strong, white setae; otherwise there are only a few short, scattered, pale setae on the front, temples, pronotum, and coxae; pubescence of body silvery, not especially dense; integument of thoracic dorsum dull, elsewhere somewhat shining.

Clypeus 3.2 times as wide as its median height, its apical margin broadly convex medially; front rather narrow, middle interocular distance 0.57 times head width, 0.92 times eye height; inner orbits strongly convergent above. Vertex slightly gibbous at ocellar triangle; postocellar line: ocellocular line = 5:7. First four antennal segments in a ratio of 15:7:29:21, segment three very slightly longer than distance between eyes at top. Pronotum broadly angulate behind; postnotum a narrow transverse band; legs slender, tibiae and tarsi with only minute, scattered spines. Wing venation as figured for *M. variegata* by Evans, 1974, except third submarginal cell much shorter than second, 1.7 times as wide as high, fourth abscissa of radius much longer than third abscissa.

This species is known only from the type female.

Literature Cited

- Evans, H. E. 1973. Studies on neotropical Pompilidae (Hymenoptera). IX. The genera of Auplopodini. *Psyche*, 80:212–226.
Evans, H. E. 1977. Studies on neotropical Pompilidae (Hymenoptera). X. Supplementary notes. *Psyche*, 83:263–270.

**OBSERVATIONS ON THE NESTING BEHAVIOR OF THREE
SPECIES OF *PLENOCULUS* FOX
(HYMENOPTERA: SPHECIDAE)**

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Plenoculus Fox is a little studied genus of relatively small fossorial wasps known predominantly from the desert regions of the New World. Detailed biological data exist for a single species, *P. davisii* Fox, where females are known to construct shallow, multicellular nests which they provision with both adult and immature hemipterans, primarily of the family Miridae (Williams, 1960; Evans, 1961; Kurczewski, 1968). Published prey records for *P. stygius* Williams and *P. propinquus* Fox similarly indicate the use of Hemiptera (Kurczewski, 1968). *P. cockerelli* Fox, however, was observed by Williams (1960) to utilize larval Lepidoptera "resembling pyralids." In the present paper we further elucidate the nesting biology of *P. propinquus*, *P. cockerelli*, and a second species preying on larvae of Lepidoptera, *P. boregensis* Williams from New Mexico.

Study Areas

Both *P. cockerelli* and *P. boregensis* were found nesting in the La Joya State Game Refuge, which lies in the Rio Grande Valley midway between the New Mexican towns of Belen and Socorro. Bordered on the western side by an extensive dune field, and occupying the marshland of this section of the river valley, the La Joya refuge contains a number of unique habitat conditions especially conducive to the nesting of a wide diversity of digger wasps. Surrounding this smaller refuge is the much larger, newly created, Sevilleta National Wildlife Refuge, which affords many other semi-arid habitat types, including the remainder of the mentioned dune field.

P. propinquus, the third species included in the present study, was observed at two locations. Some nesting data and prey records were collected at the Great Sand Dunes National Monument in southern Colorado in August, 1978. Additional prey records were obtained from specimens collected by G. E. Bohart and P. Torchio at Cornish, Utah (wasps pinned with prey), and from a population studied at La Porte, Colorado in June and July, 1979.

Ethology

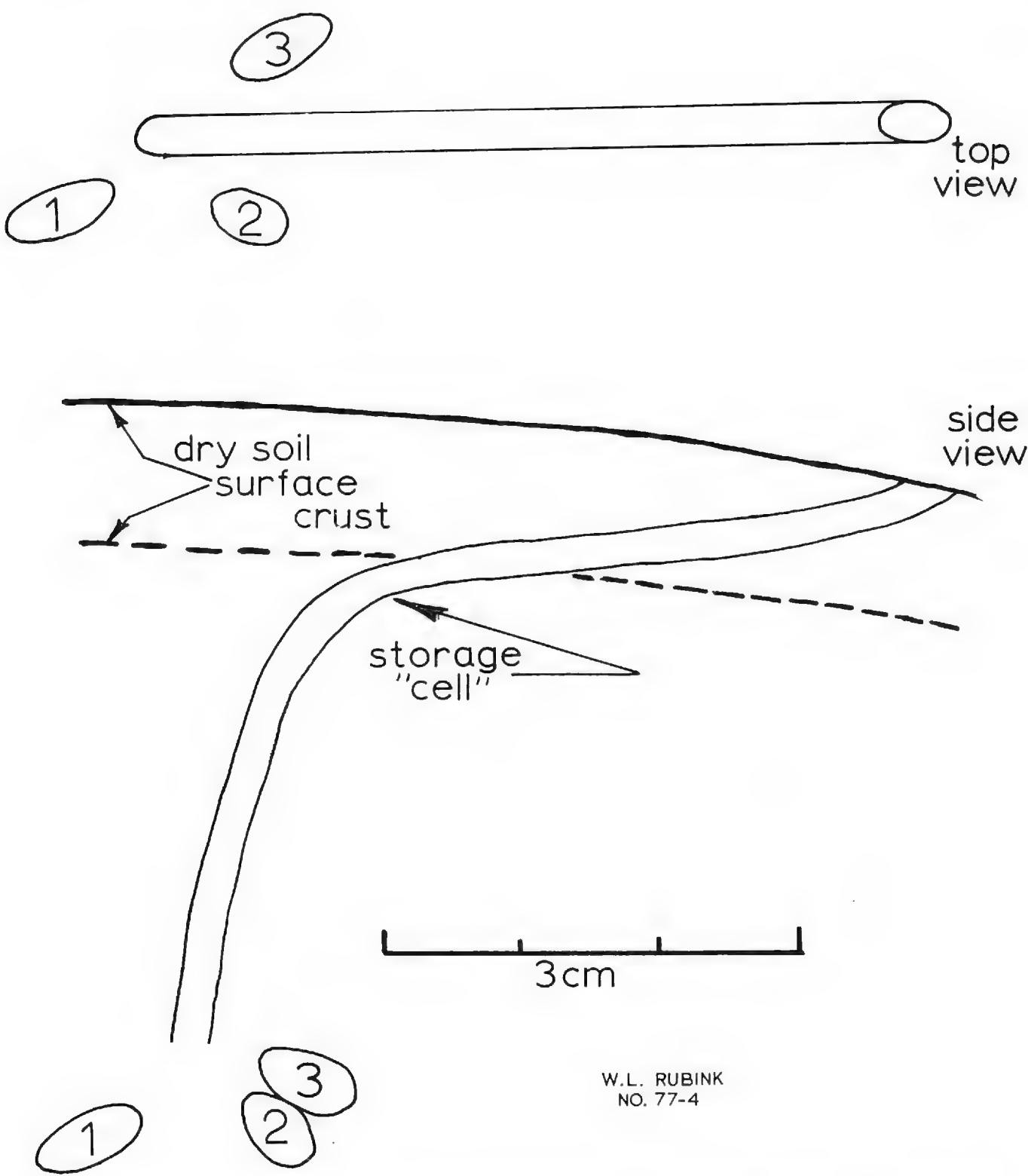
I. *Plenoculus cockerelli* Fox. The two relatively compact New Mexican aggregations of this wasp which we studied were restricted to well isolated, nearly level, hard packed, fine sandy soils beside a primitive dirt road leading into the northern portion of the La Joya Refuge. A thin, dry surface crust was present to a depth of approximately 0.5–1 cm on the nesting area and subsurface conditions were relatively moist, a result of the proximity of marshes and holding ponds which maintain the water table at a high level in the immediate area. In addition the continuous evaporation from the soil surface also imparts a visibly saline nature to the soil surface. Nesting in the same site were also *Tachytes aurulentus* (Fabricius), *Cerceris bicornuta* (Guerin) (Evans and Rubink, 1978), and *Oxybelus* sp.

Observations of *P. cockerelli* are based on two years of intermittent study. Peak levels of nesting activity at the sites varied considerably. In 1976 extensive nesting activities were recorded in mid-July, while in 1977 nesting was completed by late June; no wasps were observed nesting in late summer either year. This single peak of nesting activity observed each year suggests that this species is univoltine in nature at La Joya.

Nesting behavior in this species is similar in many respects to that described by Kurczewski (1968) for *P. davisii*. Selection of a specific location for a new nest involves flying just above a small area, landing on the soil surface repeatedly, and biting the soil at prospective nest locations. In one of the two examples of nest site selection observed, the nest was begun immediately after, and within 20 cm of a previous nest. When a suitable site is discovered, nest construction begins. Removal of excavated material is accomplished by pushing large quantities of loosened soil in a manner similar to the technique described for *P. davisii* (Kurczewski, 1968). Occasional leveling activity interspersed with removal of excavated soil prevents the accumulation of a tumulus at the nest entrance. In the two cases where nest initiation was observed, less than one hour intervened between the selection of a nest site, temporary closure, and bringing of the first caterpillar prey item to the nest.

The nest architecture of one of the ten successfully excavated nests is depicted in Fig. 1. Most nest construction activity occupied the late morning hours (1000–1200 hours), although a limited amount of leveling activity outside new nests was also observed in the afternoon (1500–1700 hours). Nest provisioning begins in the mid-morning hours (0900–1000 hours) and continues incessantly throughout the morning and early afternoon. By approximately 1600 hours very little activity is visible in the nesting area.

Prey are transported to the general vicinity of nest in flight, grasped by the middle legs of the wasp. Upon landing, the wasp carries the prey along the soil surface to near the nest entrance. She then deposits the prey tem-



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NO. 77-4

Fig. 1. Nest diagram showing architecture of an active nest of *Plenoculus cockerelli*. See text for further explanation.

porarily at that location and, using her forelegs to scrape away the temporary closure of earth, opens the nest. She then enters the burrow, turns around inside, reemerges momentarily to grasp the prey with her mandibles, and then backs into the burrow with it. The burrow is not closed from within.

Two nests examined during the period of active provisioning by the wasp

Table 1. Summary of prey records of *P. cockerelli*, *P. boregensis*, and *P. propinquus*. Records for the first two species represent lepidopterous prey exclusively.

Identity of prey items	Distribution (no. of specimens)	Location
<i>Plenoculus cockerelli</i> Fox		
Gelechiidae		
<i>Filatima</i> sp.	9	La Joya Game Refuge
<i>Aristotelia</i> sp.	9	La Joya Game Refuge
Noctuidae		
<i>Tarachidia</i> sp.	6	La Joya Game Refuge
Momphidae		
<i>Sorhagenia</i> sp.	3	La Joya Game Refuge
Lyonetiidae		
<i>Buccalatrix</i> sp.	1	La Joya Game Refuge
<i>Plenoculus boregensis</i> Williams		
Gelechiidae		
<i>Aristotelia</i> sp.	23	La Joya Game Refuge
Noctuidae		
<i>Tarachidia</i> sp.	1	La Joya Game Refuge
<i>Plenoculus propinquus</i> Fox		
Miridae (Hemiptera)		
<i>Lygus</i> sp.	20	La Porte, Colorado
<i>Philophorus hesperus</i> Knight	1	Great Sand Dunes Nat. Mon.
<i>Philophorus</i> sp.	1	Great Sand Dunes Nat. Mon.
<i>Deraecorus</i> sp.	1	Great Sand Dunes Nat. Mon.
<i>Ceratocapsis</i> sp.	1	Great Sand Dunes Nat. Mon.
Unidentified Orthotylinae	1	Great Sand Dunes Nat. Mon.
Unidentified nymphs	11	Great Sand Dunes Nat. Mon.
Mirinae nymphs	2	Cornish, Utah

revealed that the prey items are stored not in the cell, but midway down the burrow at the point where it begins a steeper descent. Neither nest contained an empty cell, so presumably cell construction takes place after the wasp has collected a suitable number of prey.

Two nests excavated late in the afternoon of the same day on which they were begun each had a single completed cell which contained several prey items. The entrance to the cell was already filled and in both cases the female wasp was found in the burrow at the top of the filled material. Older nests or nests of undetermined age contained from one to three cells and contained from one to six prey items per cell ($\bar{x}$ + S.D. = 3.3 ± 1.5 , N =

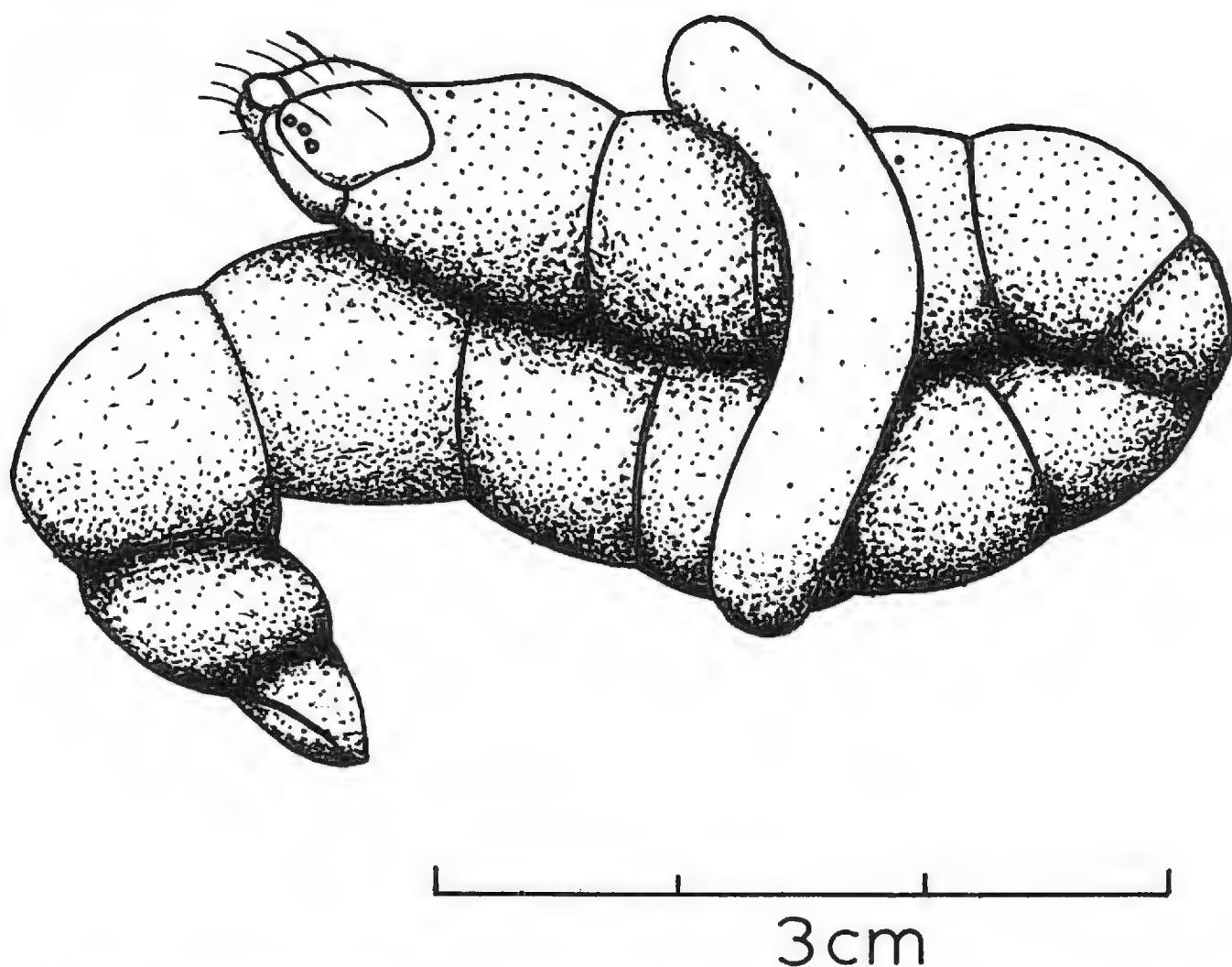


Fig. 2. Position of the egg on the lepidopterous prey item of cell number 3 of the nest of Fig. 1. See text for further explanation.

15). Prey of *P. cockerelli* were from five genera of larval Lepidoptera belonging to four families (Table 1). The egg was always laid on the last contents placed in the cell (the prey item or items nearest the traceable portion of the burrow and presumed cell entrance); however, the position of the egg on the prey varied. In two of the 5 cases where it could be ascertained, the egg overlapped one or more of the variously folded prey items (Fig. 2). In the other cases it was laid more or less longitudinally on a single caterpillar. No parasites were recorded for this species, although a single tachinid egg was found on one of the prey items. Males of this species were not observed; one specimen was recovered from a nearby malaise trap.

II. *Plenoculus boregensis* Williams. This species nests widely throughout the active dune areas of both the Sevilleta and La Joya Refuges in New Mexico. In both 1976 and 1977 nesting activities of *P. boregensis* were recorded as early as July. Early in the season it forms loose aggregations in the vegetation-free, gently sloping (10–20% slope), expanses of open sand found in blowouts and between dunes. These early season nests occupied

much the same area as that used by a large aggregation of *Bembix pallidipicta* Smith. In the late summer and early fall (August–September) more compact nesting aggregations are formed on more southerly, and slightly steeper (20–40%) slopes.

Prey transport is identical to that described for *P. cockerelli*. In contrast to *P. cockerelli*, *P. boregensis* is either bi- or multivoltine in the study area. This was determined by sifting the sand in known early and late season nesting aggregations after all 1976 nesting activity had ceased (in March 1977). In the early season nesting area only empty cocoons were discovered, while in the late season nesting site more than 300 intact cocoons (most containing diapausing larvae or prepupae) were found. A large number of these were reared in the laboratory.

The successful, complete excavation of two nests and the partial excavation of several others provided meager information concerning nest architecture in *P. boregensis*. Nests are relatively shallow. In the two excavated nests where cells were found the burrows angled into the soil at approximately a 45° angle to 10 cm depth and terminated abruptly in a cell. One of these nests contained a second cell at approximately 15 cm depth, directly below the first cell. Nest structure is thus superficially similar to that of *P. cockerelli*. This is further exemplified by the observations from several incipient nests in which the caterpillar prey were found stored, not in the cell, but in the burrow at a point several centimeters from the burrow entrance.

Numerous prey records obtained from successfully excavated nests, storage areas, or abandoned on the surface indicate a remarkable specificity (Table 1). A single record of non-*Aristotelia* prey was obtained in 1976 from a female as she was carrying it to the nest. Egg position on the prey was not observed in this species.

Forty-four wasps emerged from cocoons collected in the field in March, 1977 (1976 nesting season) and brought to the laboratory for rearing. The sex ratio of emerging adults was not significantly different from 1:1 ($\chi^2 = 0.86$, d.f. = 1; $\chi^2 = \text{n.s.}$; F/M = 0.75:1). Malaise trap sampling in both dunal and marsh habitats yielded both males and females. Sex ratios from this sampling during the 1976 nesting season produced a significantly female biased sex ratio ($\chi^2 = 26.90$; d.f. = 1; $P < 0.005$; F/M = 2.28:1). Four male mutillid parasites (*Photopsis* sp.) were reared from the cocoons of *P. boregensis*. No other parasites were found, but myrmeleontid larvae that lay in wait near the soil surface were observed to prey upon adult males. Tsuneki (1956) has also reported this for Japanese *Bembix*.

P. boregensis males are abundant in the female nesting areas throughout the nesting season where they actively alight on the soil surface and investigate open burrows and depressions in the sand, presumably in search of females. Two copulations were observed in nesting area in September, 1976.

In each case the male encountered a female as she was digging a nest. Grappling ensued and they rolled along the ground for a few seconds. After the struggle ceased the male perched on the dorsum of the upright female for 10–20 seconds before flying away.

III. *Plenocolus propinquus* Fox. This species was found nesting in well isolated, compacted, sandy soils of the Great Sand Dunes National Monument, and in well isolated, relatively less compacted soils north of the Cache la Poudre River in La Porte, Colorado. Both sites are located on level terrain, although a single female captured with prey at La Porte was apparently nesting in the relatively steep cut of a sand bank. Typical nest architecture is depicted in Fig. 3. Digging commences in late morning (actual nest site selection was not observed) and extends into the early afternoon. Limited observations suggest that as many as two cells may be completed in a single day. A tumulus does not accumulate at the nest entrance due to the progressive leveling during construction.

Prey are carried in flight to the nest head forward, venter up and grasped by the middle legs of the wasp. In a number of cases, as the wasp landed near the nest entrance, it could be seen to partially release its hold on the prey item with its legs, thus demonstrating that the mandibles are also used in prey carriage. Apparently the wasp grasps the beak of the hemipteran, as *P. davisii* has been reported to do (Evans, 1961; Kurczewski, 1968). From three to five prey items were stored per cell ($\bar{x} \pm \text{S.D.} = 3.5 \pm 0.8$, $N = 10$). Prey at the La Porte location were consistently adults of the genus *Lygus*; however, several mirid genera of both adults and immatures were used by the Great Sand Dunes population (Table 1). Egg position is identical to that described for *P. davisii* (Kurczewski, 1968). Two larvae of this species were brought to the laboratory in late June for observations of cocoon spinning behavior. Both of these larvae spun their cocoons on July 14 and emerged on July 28. This indicates that *P. propinquus* is at least bivoltine at the La Porte location.

Discussion

The addition of data on prey specificity in *Plenocolus* provides support for Williams (1960) separation of the genus into two species groups based on the presence of an emarginate, dentate clypeus (especially in the females) in the species which prey on hemipterans (the “*P. propinquus* group”), and a gently outbowed to cuneate, edentate clypeus in those species preying on larval Lepidoptera (the “*P. cockerelli*, *P. parvus* group”). The fact that both *P. propinquus* and *P. davisii* have been observed to utilize the mandibles in prey carriage (Evans, 1961; Kurczewski, 1968) leads to the suggestion that the emarginate clypeus is actually an adaptation to facilitate grasping the beak of the hemipterous prey item. The outbowed to strongly cuneate clypeus of the second species group can also be interpreted as a more efficient

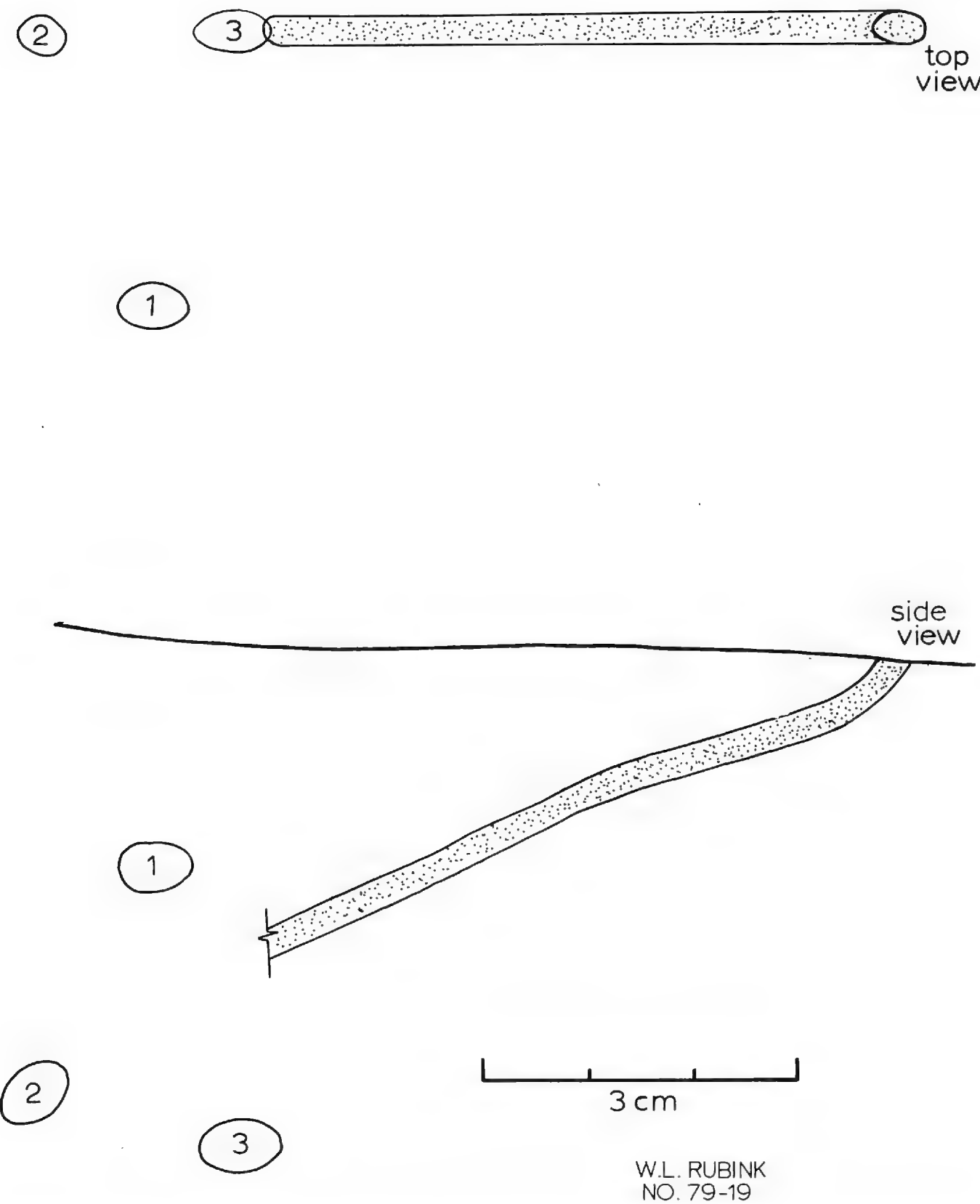


Fig. 3. Nest diagram depicting the architecture of a typical nest of *Plenoculus propinquus* after final closure.

mechanism for handling the soft-bodied, Lepidopterous prey items. The downward projecting clypeus would further aid the mandibles by holding the prey item tightly against them. Thus, although Williams (1960) considered *P. boregensis* to be rather intermediate in position, its use of lepidop-

terous prey would seem to link it more closely to the "*P. cockerelli*, *P. parvus*" species group than to the *P. propinquus* group. Male genitalic differences further support this contention (Rubink, unpublished notes). In addition, a third species of the *P. cockerelli* group from Southern Texas (undescribed, but close to *P. cuneatus* in Williams' key) has a strongly cuneate, edentate clypeus and also preys on larval lepidoptera (Rubink, unpublished observations).

The two species groups of *Plenoculus* differs in yet another way. In all the species we have observed thus far to prey on Lepidoptera they consistently make temporary closures when in search of prey. However, neither *P. davisii* nor *P. propinquus* have been observed to make temporary closures during periods of active provisioning (Evans, 1961, Kurczewski, 1968). Whether this results in differences in the incidence of parasitism is not known.

Habitat and prey preferences of *P. cockerelli* and *P. boregensis*, found nesting within a few hundred meters of each other at the La Joya site show striking differences. *P. cockerelli* is a more ephemeral species. Yearly activity is limited to a relatively short time span, and it is univoltine. Interestingly, it is also more of a generalist in its selection of lepidopterous prey items. This presumably results from non-selective hunting in a variety of habitats. *P. boregensis*, on the other hand, is probably bivoltine and active the entire summer. It, too, does not limit its activities to areas immediately adjacent to the nesting site, but is commonly found on flowers in the same habitat as *P. cockerelli*. In spite of this *P. boregensis* seems to have specialized on a narrow range of prey species.

The Hemiptera-preying species *P. propinquus*, based on the large variety of prey items, both adults and immatures, taken at the Great Sand Dunes site, also seems to be somewhat of a generalist although it preyed on only a single species of *Lygus* at the La Porte site. Thus, among the species of *Plenoculus* for which sufficient prey records are available (*P. cockerelli*, *P. boregensis*, *P. davisii*, and *P. propinquus*), only *P. boregensis* seems to be narrowly specialized.

Acknowledgments

We thank Howard Evans for help in the identification of specimens of *Plenoculus cockerelli* and *P. boregensis*, which were compared with the holotypes, and *P. propinquus*. Lepidopterous prey items were identified by D. M. Weismann (USDA Systematic Entomology Lab, Beltsville, Maryland), and hemipterous items by D. Polhemus, to whom we extend our thanks. Appreciation is also given to the New Mexico Department of Game and Fish for granting permission to do research on the La Joya State Game Refuge. Research was partially supported in conjunction with N.S.F. grants

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Literature Cited

- Evans, H. E. 1961. Notes on the Nesting Behavior of *Plenoculus davisii* Fox. (Hymenoptera: Sphecidae). Entomol. News., 72:225-228.
- Evans, H. E., and W. L. Rubink. 1978. Observations on prey and nests of seven species of *Cerceris* (Hymenoptera: Sphecidae). Great Basin Naturalist, 38(1):59-63.
- Kurczewski, Frank E. 1968. Nesting Behavior of *Plenoculus davisii* (Hymenoptera: Sphecidae, Larinae). J. Kans. Entomol. Soc., 41(2):179-207.
- Tsuneki, K. 1956. Ethological studies on *Bembix niponica* Smith. I. Biological Part. Mem. Fac. Lib. Arts, Fukui Univ., Ser. II, no. 7, p. 125.
- Williams, F. X. 1960. The Wasps of the Genus *Plenoculus* (Hymenoptera: Sphecidae, Larinae). Proc. Calif. Acad. Sci., 31(1):1-49.

Footnote

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NOTICE

The Seventh International Symposium on Plecoptera will be held August 19-22, 1980, at the Nara Women's University in Nara, Japan.

The Plecoptera meetings are being held in conjunction with the XVI International Congress of Entomology (Kyoto, 3-9 August 1980) and the XXI Congress of the International Association of Theoretical and Applied Limnology SIL (Kyoto, 24-31 August 1980).

OBITUARY

HORACE MORTON ARMITAGE, 1890-1980

Horace Morton Armitage, 89, retired Chief of the Bureau of Entomology, California Department of Agriculture, a nationally known expert in insect pest control, passed away January 23, 1980, at Chula Vista, California.

Born in Butte, Montana in 1890, and educated in Corona, California, he started his career as field entomologist with the old Land and Town Company of Chula Vista in 1911. Following the "big freeze," he became San Diego County Horticultural Inspector in 1913, and Commissioner in 1915. In 1918, he entered State service as Assistant Superintendent of the State insectary at Alhambra. When this service was transferred to the University of California at Riverside, he became Assistant Entomologist in charge of its insectary at Whittier. In 1923 he was appointed Deputy Agricultural Commissioner of Los Angeles County in charge of the county insectary.

In 1931 he returned to State service as Associate Chief of the Bureau of Entomology and Plant Quarantine in charge of the Bureau's work at the Port of San Francisco. When the Bureau was divided in 1945, he became Chief of the new Bureau of Entomology in Sacramento, a position he held until retirement in 1955.

As Chief of the Bureau of Entomology, he was responsible for detecting the presence of new major insect pests of agriculture within the State, and with attempting their eradication before they became firmly established. In this respect he planned and carried out eradication measures directed against the Western grapeleaf skeletonizer, which involved the elimination of all wild grapes within the confines of San Diego County, as well as protective measures designed to prevent the spread of the Mexican fruit fly into California from Lower California, which involved the spraying every three weeks of all citrus and deciduous host trees within five miles of the Mexican border in San Diego and Imperial Counties.

Other projects were directed against the Mexican bean beetle in Ventura County, the citrus whitefly in Orange, Los Angeles, Fresno, Madera and San Benito Counties, the cherry fruit fly in Siskiyou County, Hall's scale in cooperation with USDA in Butte and Yolo Counties, and the Khapra beetle, a major pest of stored grains, in all Southern and many Northern California counties. The last named project required unusual methods involving the covering of huge storage warehouses and mills with gastight tents to permit their fumigation.

In 1949 he acted as technical advisor to a sub-committee of the State Legislative Joint Interim Committee on Agriculture and Livestock Problems, visiting the Hawaiian Islands to review the Oriental fruit fly problem



as it concerned the California fruit industry. His work with the Mexican fruit fly required his presence in Mexico City to confer with USDA authorities and research workers. As a consulting entomologist following retirement, he outlined for the Canadian Department of Agriculture procedures for the eradication of a suspected infestation of Oriental fruit moth, a serious pest of deciduous fruits, in the Okanagan Valley of British Columbia.

In addition to eradication problems, he was responsible for conducting state-wide control measures against grasshoppers, and against the sugarbeet leafhopper, the latter a major pest of a wide range of high value crops in the San Joaquin Valley.

He was a long-standing member of the Entomological Society of America (photograph, courtesy of E.S.A.), serving on the Governing Board for five

years and its President in 1957. In 1967 he was given the single honor of being made an Honorary Member. He was a longtime member of the American Association for the Advancement of Science; past-President of the Pacific Branch of the E.S.A., an organization of the 11 western states; past-President of the Pacific Coast Entomological Society; also of the Northern California Entomology Club and the Southern California Entomological Club of which he was a charter member.

He was the author of many published articles pertaining to his activities appearing in the Bulletins of the State Department of Agriculture, the University of California, the USDA and in various other major agricultural publications.

His wife, the former Adah Monroe, passed away in May 1978. We express our sympathy to his daughters, Mrs. Thomas Nielssen of National City, California and Mrs. Kenneth Street of Alamo, California.

Mr. Armitage was well respected by those who knew and worked with him. The following are some quotations from various co-workers and other friends concerning "Mort." "He was not one to set on testimonials." "A man of vision, conviction, action." "When you worked for Mort, you worked with him." "Not ivory tower recluse." "You always knew who was boss." "Not a diplomat at expense of job to be done." "Good friend in adversity or other differences." "Well guarded sense of humor." "Vivid personality." "Funniest when going got roughest."

Above the main entrance to State of California Office Building #1 in Sacramento, is found in bold lettering these words from a poem by Sam Foss: "BRING ME MEN TO MATCH MY MOUNTAINS." H. M. (Mort) Armitage was such a man.

Robert W. Harper and George M. Buxton

**OBSERVATIONS ON THE NESTING BIOLOGY
OF *MELISSODES PERSIMILIS* CKLL.
(HYMENOPTERA: ANTHOPHORIDAE)**

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Melissodes is the largest genus of Eucerini in the Western Hemisphere, with about 122 species (LaBerge, 1956a, 1956b, 1957, 1961, 1963). In his extensive studies of this group LaBerge described the nesting biology and floral visitation records for many species. Observations on the sleeping habits of male *Melissodes* have been made by Banks (1902) on *M. bimaculata* (Lepeletier); Mathewson and Daly (1955) on *M. perplexa* Cresson; Evans and Linsley (1960) on *M. paroselae* Cockerell and *M. spp.* near *confusa* Cresson; Linsley (1962) on *M. paroselae* and *M. tristis* Cockerell; LaBerge (1961) on *M. confusa* Cresson; Chemsak and Thorp (1962) on *M. robustior* Cockerell; Thorp and Chemsak (1964) on *M. pallidisignata*; Clement (1973) on *M. rustica* (Say). Descriptions of the nesting biology and larval morphology of *Melissodes* are still quite fragmentary. *Melissodes composita* (Hurd and Linsley, 1959), *M. pallidisignata* (Thorp and Chemsak, 1964) and *M. rustica* (Clement, 1973) have been best studied. Additional data on nesting biology are presented by Ashmead (1894) for *M. bimaculata*; Graenicher (1905) for *M. trinodis* Robertson; Rau (1922) for *M. agilis* Cresson; Hicks (1926) for *M. mizeae* Cockerell and *M. subagilis* (Cockerell); Custer (1928, 1929) for *M. obliqua* Say; Scullen (1928) for *M. mysops* Cockerell; Hicks (1936) for *M. timberlakei* Cockerell; Linsley (1946) for *M. timberlakei*; Janvier (1955) for *M. sexcincta* (Lepeletier); Linsley, MacSwain and Smith (1955) and MacSwain (1958) for *M. robustior*; Michener and Lange (1958) for *M. nigroaenea* (Smith); Hurd and Linsley (1959) for *M. composita* Tucker; Thorp and Chemsak (1964) for *M. pallidisignata*; and Clement (1973) for *M. rustica* (Say). Descriptions and figures of mature larvae of *Melissodes* have been provided by Michener (1953), Rozen (1965) and by Clement (1973). Clement (1973) provides the most recent information on the genus.

Melissodes persimilis is known from Guatemala, Honduras and Panama. It is related to the northern species *M. montana* and *M. confusa* (LaBerge, 1956a, 1956b, 1957; Michener, 1944). It is a moderate-sized bee, the females average approximately 12 mm in length and the males ranging from 9–12 mm long. This species is sexually dimorphic in that the slender males are smaller with longer antennae, while the females are more robust and darker in color. Body color varies from an ochraceous to dull ferrugineous brown.

Our studies included preliminary observations on the nesting biology of *M. persimilis* and augment the existing somewhat fragmentary nesting and life history data for this genus.

Nesting Biology

A small nesting site (less than 4 m²) of *Melissodes* (*Eumelissodes*) *persimilis* Ckll. was discovered on January 31, 1972. It contained about one hundred active burrows. The site was located about one-half kilometer behind the Organization for Tropical Studies, Finca Las Cruces field station (now the Las Cruces Tropical Botanic Garden) at San Vito de Java, Puntarenas Province, Costa Rica. This area is at an elevation of approximately 1400 meters and has been described as a premontane wet forest by Holdridge (1967). The bees were tunneling into a widened portion of the main trail in loosely compacted, light-colored, sandy soil, devoid of vegetation except some grasses along the edges. To both sides of the trail (about 5 meters on both sides and adjacent to the site) some secondary growth occurred in front of the lush vegetation of the wet forest. We studied these bees on January 31 and February 1.

Female *Melissodes* visited flowers (a number of unidentified composites, Asteraceae, growing near the aggregative nest site) for pollen. An analysis of the pollen loads from several bees indicated a high percentage of composite pollen suggesting that *M. persimilis* is oligolectic on composites. Primary nectar sources for males or females were not discovered.

During both days of observation, warm temperatures were prevalent and bees were observed flying over the site by 0900 EST. Male bees were the first to fly in the morning. By 0900, hundreds of males were seen flying very low (@ 3 cm) over the site. They flew very rapidly in erratic flight paths, occasionally alighting, entering a burrow momentarily, or attempting copulation with a female. The ratio of visible males to females was about 10 or 15 males to every female. Some samples were taken by rapidly sweeping over the nests with an aerial insect net. Every observed mating took place at the nesting site and males did not patrol the flowers that were visited by conspecific females. Males patrolling the nesting aggregation attempted to copulate with emerging females as well as those returning from foraging "bouts." Returning pollen-laden females were apparently unreceptive to-

ward persistent male attacks. Pairs of bees dropped to the ground near burrow entrances where "courtship" movements and copulation (movements and intromission) ensued. The duration of copulation activity was approximately one minute in several timed cases. Additional patrolling males often attempted to interfere with paired or copulating bees. Often there were as many as six males engaged in this activity (attempted displacement of the primary male), and the groups of bees moved as a writhing ball across the forest trail. Females that were provisioning their cells often repulsed males. It was not determined whether a single female provisioned more than one nest during her lifetime. Although the nests were grouped into a tight aggregation, there appeared to be no cooperation among neighboring females in nest construction.

Females spent the night singly in their nests and males spent the night singly or communally in other old, or possibly new burrows.

Females used their mandibles and forelegs to excavate the burrows. Sand loosened while digging was propelled out of the tunnel with the posterior legs, as the bees backed out of their burrows. Loose sand was deposited in a circular tumulus about the opening (Fig. 1). The entrance is loosely plugged with sand through which the female passes each time she enters the nest. The burrow was filled all the way down with loose fill soil upon completion of the provisioning by the female. Bees were observed provisioning cells with two types of composite pollen. The most common was a deep yellow-orange, whereas the other was a lighter yellow. Female bees emerging from their burrows following a provisioning trip always paused briefly at the entrance of their nests before taking flight for the next trip. This behavior was described by Clement (1973) who considered it to be a response to avoid attracting parasitic bees and other insects to the vicinity of the burrow. No evidence of parasitism from other bees was observed while watching the activity in the nesting area and no parasitic bee larvae were excavated from *Melissodes* cells. However, a small red mutillid female entered one burrow. The wasp remained in the burrow for 30 seconds and came up with her head lightly dusted with pollen.

The burrow averages 5–6 mm in diameter and culminates in a single cell 8 to 12 cm below the surface of the soil (Fig. 1). The burrows went straight down and angled only a centimeter or less above the cell (Fig. 1A). The cell was straight sided and symmetrical with a concave bottom. The maximum internal cell diameter was 8 mm. The curved egg ranged from 2.5 to 3 mm long ($N = 3$) and was attached by one end (probably its posterior) to the center of a pollen ball with a slightly concave upper surface. The egg was dull white in color, not shiny. This surface was moist and glistened as if the female bee had applied a light layer of nectar to the surface of the pollen mass. The cells were not rigid, crumbled easily, and could not be excavated intact. The orientation of the cells was angular with respect to the soil

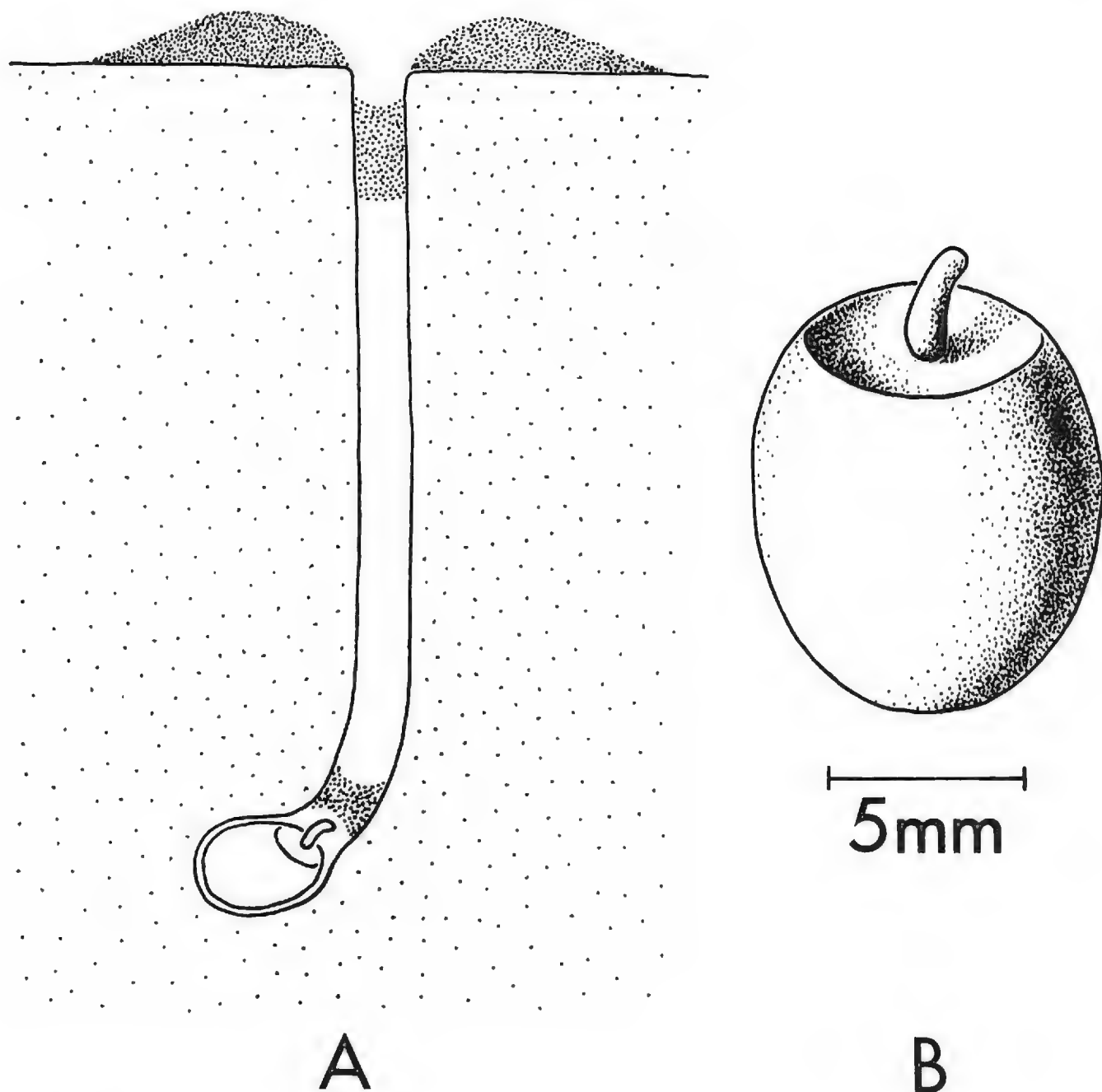


Fig. 1. Nest architecture of *Melissodes persimilis* Ckll. A. Complete nest showing radial tumulus, opening plug and cap over the provisioned cell. B. Pollen ball showing the apical attachment of the egg by one end to the concave surface of the pollen mass.

surface, and this angle was somewhat variable. The cell linings were smooth but not shiny and were not lined with wax or other adult secretions. No information was obtained on cell closure although it may have been a concave spiral as viewed from inside, as described for other eucerines (Rozen, 1964, 1969, 1974). The provisions (pollen ball) occupied the entire rear portion of the cell with no space between the pollen and the cell walls. The surface of the provisions were slightly concave near the point of egg attachment. There was no apparent odor or swelling of provisions to indicate the active fermentation of the brood provisions. Eggs, young instars and pre-

defecating larvae were present at the same time in the site. No data were gathered on pupal morphology or cocoon construction because these stages were not present during our observations.

Several pre-defecating larvae were collected and preserved. These were critically examined and found to differ insignificantly from those *Melissodes* species illustrated by previous workers (Michener, 1953; Rozen, 1965; Clement, 1973). Representative larvae are now on deposit in the larval bee collection under the care of Jerome G. Rozen (American Museum of Natural History).

Discussion

Our study of *M. persimilis* has revealed both similarities and differences with *M. (Eumelissodes) pallidisignata* and *M. rustica* (Thorp and Chemsak, 1964; Clement, 1973).

In all these species, digging behavior is very similar and a loose plug of sand forms a burrow plug through which the female must pass each time she enters or leaves the nest. This appears to be an adaptation to prevent parasitic bees and other insects from entering or easily locating the burrow (Clement, 1973). In *M. pallidisignata*, like *M. persimilis*, the burrow contains an arch-like section near the end of the tunnel that prevents the sand plug from entering the cell while it is being provisioned. This apparently serves the same function as does the short horizontal section of *M. rustica* burrows (Clement, 1973). Nests of both *M. rustica* and *M. persimilis* seem to be more architecturally uniform than do those of *M. pallidisignata*. In all three species only one cell per burrow is constructed. All three are solitary bees which nest in at least fairly large and dense aggregations.

There are also differences in the ethology of the three species. Males of *M. pallidisignata* either spend the night on floral disks or more often in the loose plug of active burrows (Thorp and Chemsak, 1964). Males of *M. rustica* apparently spend their nights in old burrows or nearby crevices in volcanic rocks (Clement, 1973) and males of *M. persimilis* "sleep" in old and possibly new burrows. In pollen masses collected by females of *M. persimilis* there was no evident fermenting odor as was reported in the other two taxa. It has also been suggested by Thorp and Chemsak (1964) that the liquification of the surface layer of the pollen mass was due to larval secretions by early instars, as they were unable to find it on pollen masses with eggs alone. Clement (1973) agreed with these findings and reported a similar condition in the pollen mass of *M. rustica*. Our findings for *M. persimilis* suggest an alternative because the liquid layer was present with both eggs and early instar larvae, this layer may be the final addition of liquid nectar left by the provisioning female bee.

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Literature Cited

- Ashmead, W. H. 1894. The habits of the aculeate Hymenoptera I. *Psyche*, 7:19–26.
- Banks, N. 1902. Sleeping habits of certain Hymenoptera. *J. New York Entomol. Soc.*, 10:209–214.
- Chemsak, J. A., and R. W. Thorp. 1962. Note on the sleeping habits of males of *Melissodes robustior* Cockerell (Hymenoptera: Apoidea). *Pan-Pac. Entomol.*, 38:53–55.
- Clement, S. L. 1973. The nesting biology of *Melissodes (Eumelissodes) rustica* (Say), with a description of the larva (Hymenoptera: Anthophoridae). *J. Kans. Entomol. Soc.*, 46:516–525.
- Custer, C. P. 1928. On the nesting habits of *Melissodes* Latr. *Can. Entomol.*, 60:28–31.
- Custer, C. P. 1929. Notes on cocoons and parasites of *Melissodes obliqua* and nests of *Perdita opuntiae*. *Psyche*, 36:293–295.
- Evans, H. E., and E. G. Linsley. 1960. Notes on sleeping aggregation of solitary bees and wasps. *Bull. So. Calif. Acad. Sci.*, 59:30–37.
- Graenicher, S. 1905. Some observations on the life history and habits of parasitic bees. *Bull. Wisc. Nat. Hist. Soc.*, 3:153–167.
- Hicks, C. H. 1926. Nesting habits and parasites of certain bees of Boulder County, Colorado. *Univ. Colo. Studies*. Sept. 1926, 217–252 pp.
- Hicks, C. H. 1936. Nesting habits of certain western bees. *Can. Entomol.*, 68:47–52.
- Holdridge, L. R. 1967. *Life Zone Ecology*. Tropical Science Center, San Jose, Costa Rica, Revised ed.
- Hurd, P. D., and E. G. Linsley. 1959. Observations on the nest-site behavior of *Melissodes composita* Tucker and its parasites, with notes on the communal uses of nest entrances (Hymenoptera: Apoidea). *Entomol. News*, 70:141–146.
- Janvier, H. 1955. Les nid et la nidifications chez quelques abeilles des Andes tropicales. *Ann. Sci. Nat. Zool.*, 17:311–349.
- LaBerge, W. E. 1956a. A revision of the bees of the genus *Melissodes* in the North and Central America. Part I. *Univ. Kans. Sci. Bull.*, 37:911–1194.
- LaBerge, W. E. 1956b. *Ibid.* Part II, 38:533–578.
- LaBerge, W. E. 1957. The genera of the bees of the tribe Eucerini in North and Central America. *Amer. Mus. Nov.*, 1837:1–44.
- LaBerge, W. E. 1961. A revision of the bees of the genus *Melissodes* in North and Central America. Part III. *Univ. Kans. Sci. Bull.*, 42:283–663.

- LaBerge, W. E. 1963. New species and records of little-known species of *Melissodes* from North America. Univ. Nebr. St. Mus. Bull., 4:227–242.
- Linsley, E. G. 1946. Insect pollinators of alfalfa in California. J. Econ. Entomol., 39:18–29.
- Linsley, E. G. 1962. Sleeping aggregations of aculeate Hymenoptera—II. Ann. Entomol. Soc. Amer., 55:148–164.
- Linsley, E. G., J. W. MacSwain, and R. F. Smith. 1955. Biological observations on *Xenoglossa fulva* Smith with some generalizations on biological characters of other eucerine bees. Bull. So. Calif. Acad. Sci., 54:128–141.
- MacSwain, J. W. 1958. Longevity of some anthophorid bee larvae (Hymenoptera: Apoidea). Pan-Pac. Entomol., 34:40.
- Mathewson, J. A., and H. V. Daly. 1955. A brief note on the sleep of male *Melissodes* (Hymenoptera: Apidae). J. Kans. Entomol. Soc., 28:120.
- Michener, C. D. 1944. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). Bull. Amer. Mus. Nat. Hist., 82:151–326.
- Michener, C. D. 1953. Comparative morphological and systematic studies of bee larvae with a key to the families of hymenopterous larvae. Univ. Kans. Sci. Bull., 35:987–1102.
- Michener, C. D., and R. B. Lange. 1958. Observations on the ethology of Neotropical anthophorine bees (Hymenoptera: Apoidea). Univ. Kans. Sci. Bull., 39:69–96.
- Rau, P. 1922. Ecological and behavior notes on Missouri insects. Trans. Acad. Sci., St. Louis, 24:1–71.
- Rozen, J. G. 1964. The biology of *Svastra obliqua obliqua* (Say), with a taxonomic description of its larvae (Apoidea, Anthophoridae). Amer. Mus. Novitates, 2170:1–13.
- Rozen, J. G. 1965. The larvae of the Anthophoridae (Hymenoptera: Apoidea) Part I. Introduction, Eucerini, and Centridini (Anthophorinae). Amer. Mus. Nov., 2233:1–27.
- Rozen, J. G. 1969. Biological notes on the bee *Tetralonia minuta* and its cleptoparasite, *Morgania histrio transvaalensis* (Hymenoptera: Anthophoridae). Proc. Ent. Soc. Washington, 71:102–107.
- Rozen, J. G. 1974. Nest biology of the eucerine bee *Thygater analis* (Hymenoptera: Anthophoridae). Jour. New York Ent. Soc., 82:230–234.
- Scullen, H. A. 1928. *Melissodes mysops* Cockerell nesting in Oregon (Anthophoridae: Hymenoptera). Pan-Pac. Entomol., 4:176.
- Thorp, R. W., and J. A. Chemsak. 1964. Biological observations on *Melissodes* (*Eumelissodes*) *pallidisignata*. Pan-Pac. Entomol., 40:75–83.

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**EMBRYONIC DIAPAUSE IN *TIPULA SIMPLEX* AND THE ACTION
OF PHOTOPERIOD IN ITS TERMINATION
(DIPTERA: TIPULIDAE)**

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Most crane fly larvae are stream dwelling or live in areas where there is a constant supply of moisture (Alexander, 1967), but there are reports of species thriving in fairly dry soil on almost all continents (Alexander, 1920; 1931). A few of these species, including *Tipula simplex* of the Central Valley of California, live through cyclic droughts (Hartman and Hynes, 1977).

Most crane fly eggs have a development time of one to three weeks, depending on ambient temperature, and require constant moisture (Hemmingsen, 1956; Byers, 1961; Hynes, 1963; Hartman, 1966). The eggs of *Tipula simplex* have a stadium of 8 months and require six to seven months of drought, two periods of moisture, separated by a second drying period, under a long scotophase before they will hatch (Hartman and Hynes, 1977; Hartman and Hynes, in press).

Based on the difference in environmental conditions in which they live, egg stadium length, and moisture and photoperoid regimen necessary to induce hatching between *Tipula simplex* and other tipulids, we have postulated a summer dormancy for *T. simplex*. Mansingh (1971) classifies dormancies into quiescence, oligopause or diapause based on physiological characteristics of the dormant stage and relates the type to ecological characteristics of the environment.

We report here on tests that we have run to determine whether the dormancy in *Tipula simplex* eggs is quiescence, oligopause, or diapause. Determinations were: time of the onset of dormancy; amount of embryonic development occurring during dormancy; time of refractory and activation phases; oxygen consumption rates; effect of photoperiod on dormancy termination.

Table 1. Percent hatch of eggs under photoperiods of varying lengths.

N of eggs	Month of moistening	Photoperiod	T	% Hatch
400	December	6L:6D	12	29 a
400	December	18L:6D	24	5 b
400	December	30L:6D	36	22 a
400	December	42L:6D	48	9 b

Numbers followed by the same letter are not significantly different ($P < .05$) according to Duncan's multiple range test.

Materials and Methods

Collection of eggs.—The *Tipula simplex* eggs were collected in the field in Tulare County, California, using previously described techniques (Hartman and Hynes, in press).

Sectioning and staining.—One hundred eggs were fixed monthly from Apr. to Sept. in Carnoy and Lebrun's fluid (Galigher and Kozloff, 1964), imbedded according to the n-butyl methacrylate method of Woodring and Cook (1962) as modified by Smith and Hynes (1966), cut at 10 μ on an AO rotary microtome, stained with acid fuchsin and Mallory's triple, and destained with 2% phosphomolybdic acid (Galigher and Kozloff, 1964).

Induction of hatching.—To induce hatching, eggs were transferred onto filter paper in a water-tight container 9 cm in diameter. The filter paper was moistened with 1.6 ml of distilled water and placed at 15° at a 10L:14D photoperiod (light phase = 0.76 lux). After two weeks, the lids were removed for one day, allowing the paper to dry. After an additional week, the paper was remoistened with 1.6 ml of distilled water and the lid was replaced. Hatches were counted twice weekly. Four replicates were used for each test.

To study the timing of the onset of dormancy, the refractory, and the activation phases, we attempted to induce hatching in 400 eggs every month for a year, using the methods described above.

To study the effect of photoperiod, eggs were treated as above except that they were dried until October, and when moistened, were placed at 10L:14D; 12L:12D; 14L:10D; or 16L:8D for the duration of the test.

To determine the mechanism of photoperiod interpretation, embryos were treated to induce hatching in December, but were placed in a photoperiod of 6L:6D, 18L:6D, 30L:6D, or 42L:6D.

Oxygen consumption.—500 eggs were placed on filter paper in each of ten 15 ml Gilson flasks. 10% KOH was added to the side arm of each flask

to absorb CO_2 . The eggs were dried and moistened in the proper regimen to induce hatching. Oxygen consumption was measured with a Gilson Respirometer (loaned by the J. G. Boswell Company).

Diapause termination.—The eggs of *Tipula simplex* have a sclerotized chorion, which makes it impossible to view embryonic development *in vivo*. The oxygen consumption rate of each egg is too low to use it as a quantitative measure of the percent of eggs which break diapause. We were forced to use percent of eggs hatching as a measure of diapause termination, which, due to embryonic mortality, will underestimate consistently the number of eggs which terminate diapause.

Results

Time of the onset of dormancy.—Eggs enter dormancy within one month of oviposition, even though photoperiod is adjusted to a 10L:14D condition. The refractory period extends from the time of oviposition (March) until August. From August through January they are in the activation phase, then in February, they return to the refractory phase.

Embryonic development during dormancy.—Embryos which had been collected in the field and stored without moisture remained in the precleavage, or what Johanssen and Butt (1941) call the fusion nucleus stage. Development does not resume until the eggs are moistened in the fall. This is the earliest recorded dormancy condition in any insect. Lees (1955) states that “no species is known in which diapause supervenes before the formation of the blastoderm.” A survey of the literature since 1955 did not reveal any other cases of diapause at this early stage of development. Although Iba and Inoue (1972) indicate that the egg of the rhombic-marked leaf hopper, *Hishimonus stellatus*, entered diapause immediately after oviposition, they do not indicate the stage of embryonic development at which diapause occurs.

Oxygen consumption rates.—Oxygen consumption varied tremendously with variations in the environmental conditions for hatching. During the summer drought, O_2 consumption was measured at $1.2 \mu\text{l}/100 \text{ eggs/hr}$ (S.E. = 0.4). Twenty-four hours after moistening the oxygen consumption rate had risen to $4.0 \mu\text{l}/100 \text{ eggs/hr}$ (S.E. = 0.2).

Interpretation of day length/night length.—Previous results indicate that a scotophase of 12–14 hours is most effective in inducing diapause termination. Two major models have been proposed to explain how living things time the scotophase. In the hourglass model, the length of night is measured by accumulation of some unknown metabolite, which is destroyed during the day. In the oscillator model, circadian clocks are involved (Pittendrigh, 1972). If circadian oscillations are involved, then the eggs should break dormancy and hatch whenever darkness occurs in the first and third quarters

of a 24 hour day, whether the darkness is in both quarters in the same 24 hour period or not. If the hourglass system is working, then eggs should break dormancy and hatch when the minimum scotophase is coupled with a light requirement of any length above minimum. That is, if an oscillator system is involved, then the eggs should break dormancy and hatch under a light regimen of 12L:12D, 6L:6D, or 30L:6D. If the hourglass system is involved, then 12L:12D is the only light regimen which will terminate diapause.

The results, shown in Table 1, indicate that *Tipula simplex* embryos break dormancy whenever the scotophase occurs during the first and/or third quarter of a 24 hour day, thus indicating that the biological clock in *Tipula simplex* eggs is an oscillator system.

Discussion

Mansingh (1971) characterizes dormancy on the basis of both physiological and ecological characteristics. The physiological characteristics of diapause described by Mansingh (1971) include: entrance into dormancy well before the appearance of the adversity; growth arrest; complex biochemical changes; and a refractory period at least half the length of the normal dormancy period. *Tipula simplex* eggs enter dormancy in the fusion nucleus stage, which occurs soon after fertilization. This stage is reached three months before the onset of the adversity (June in Tulare County). The growth arrest observed is characteristic of diapause but may also be characteristic of oligopause (Mansingh, 1971). Complex biochemical changes associated with the termination of diapause have been characterized for *T. simplex* eggs only by changes in oxygen consumption rates so far. *Tipula simplex* eggs have the refractory period extended from March to August, which is more than half of the normal dormancy period (March to October). Therefore on the basis of the physiological data, *Tipula simplex* dormancy may be classified as true diapause.

Mansingh's work (1971) has been criticized by Thiele (1973), for failure to separate diapause into parapause (genetically fixed stage of development with no clear phase of induction) and eudiapause (facultative diapause with a clear induction phase), and for his attempts to correlate dormancy with distribution.

Mansingh (1971) states that an insect with a diapause stage has its range confined to an area of extreme adversity, and this adversity is long term and cyclic. Insects with an oligopause stage are more wide ranging and the adversity is not as extreme, but is cyclic. In quiescent stages the adversity is unanticipated. *Tipula simplex* has a geographical distribution from Contra Costa County north to Sacramento County, and a separate population in Tulare County, all in California (Alexander, 1967). Within this geographical

range, it is confined to those unirrigated lands which undergo seasonal drought from May to Oct. At these times soil moisture is as low as 0.2% and soil temperature as high as 50°C (Hartman and Hynes, 1977). The habitat of *Tipula simplex* diapause neatly fits into the extreme cyclic environment predicted by Mansingh for diapause conditions.

The oscillator system of biological clock is much more common than the hourglass system (Beck, 1968). Pittendrigh (1971) indicates that there are two possible oscillator systems, an external coincidence and an internal coincidence system. Whether the system in *T. simplex* is an external or an internal coincidence remains to be determined.

Conclusions

On the basis of ecological and physiological characteristics of dormancy in *Tipula simplex* eggs, we postulate that summer dormancy is a true diapause condition. Work is continuing on the characterization of the condition existing during the obligatory drying period between the first and second fall moistenings. A long scotophase is essential for termination of diapause. The biological clock involved is an oscillator type.

Literature Cited

- Alexander, C. P. 1967. The crane flies of California. Bull. Calif. Insect Surv. Vol. 8. Univ. Calif. Press, Berkeley and Los Angeles, 269 p.
- Beck, S. D. 1968. Insect Photoperiodism. Academic Press, New York, 288 p.
- Byers, G. W. 1961. The crane fly genus *Dolichopeza* in North America. Univ. Kans. Sci. Bull., 42(6):665-924.
- Galigher, A. E., and E. N. Kozloff. 1964. Essentials of practical microtechniques. Lea & Febiger, Philadelphia, 484 p.
- Hartman, M. J. 1966. A study of organogenesis in the egg of *Erioptera (Trimicra) pilipes* (Tipulidae: Diptera). Unpublished thesis, Cal. Poly., San Luis Obispo.
- Hartman, M. J., and C. D. Hynes. 1977. The biology of the range crane fly, *Tipula simplex* (Diptera: Tipulidae). Pan-Pacific Entomol., 53:118-123.
- Hartman, M. J., and C. D. Hynes. Environmental factors affecting the hatching success of *Tipula simplex* eggs (Diptera: Tipulidae). Submitted to Pan-Pacific Entomol.
- Hemmingsen, A. M. 1965. The lotic crane fly *Tipula saginata* Bergroth and the adaptive radiation of the Tipulinae, with a test of Dyar's Law. Vidensk Medd. Dan Naturhist. Foren., 128:93-150.
- Hynes, C. D. 1963. Description of the immature stages of *Cryptolabis magnistyla* Alexander. Pan-Pacific Entomol., 39:255-260.
- Iba, M., and S. Inoue. 1972. On the diapause in hibernating eggs of the rhombic-marked leafroller, *Hishimonus sellatus* Uhler. J. Seric. Sci. Jpn., 41(5):365-370.
- Johannsen, O. A., and F. H. Butt. 1941. Embryology of insects and myriapods. McGraw-Hill, New York, 462 p.
- Lees, A. D. 1955. The physiology of diapause in arthropods. Cambridge Univ. Press, 150 p.
- Mansingh, A. 1971. Physiological classification of dormancies in insects. Canadian Entomol., 103:983-1009.

- Pittendrigh, C. S. 1972. Circadian surfaces and the diversity of possible roles of circadian organization in photoperiodic induction. *Proc. Nat. Acad. Sci. USA*, 69:2734–2737.
- Smith, H. G., and C. D. Hynes. 1966. Modifications of the n-butyl methacrylate imbedding method as applied to insect larval head capsules. *Ann. Entomol. Soc. Amer.*, 59:230.
- Thiele, H. U. 1973. Remarks about Mansingh's and Müller's classifications of dormancies in insects. *Canad. Entomol.*, 105:925–928.
- Woodring, J. P., and E. F. Cook. 1962. The internal anatomy, reproductive physiology and molting process of *Ceratozetes cisalpinus* (Acarina: Orobatei). *Ann. Entomol. Soc. Amer.*, 55:164–181.

Footnote

The authors would like to acknowledge the assistance of the Boston Land Company and the Tulare County Agricultural Commission.

BOOK REVIEW

Ronald A. Russo. 1979. *Plant Galls of the California Region*. The Boxwood Press, Pacific Grove, California. xi + 203 pages, 190 text figures, bibliography, taxonomic and subject indexes. \$8.95, paper.

There is at long last a book to aid in identifying plant galls induced by various biological agents in California. It is simple enough for the beginner and yet complete enough to be of value to serious students of the various groups of gall inducers. It reflects 10 years of the author's fascination with the intricate biochemical relationships between the host plant and the gall inducers and the great beauty of the galls they cause. The only other comparable prior works were either too broad in geographic range or too specialized. The paperback book is small enough and the simple line drawings are in most cases adequate to identify the galls in the field.

Except for an editorial prerequisite to use the terms "larvas" and "pupas" which is frustrating to the author and some readers, the natural history discussions are enjoyably informative. I had to take turns getting to read my own copy. Russo discusses most of the conspicuous galls and some of the obscure forms. Information on additional species is being compiled for expanded treatment of at least the cynipid gall wasps, which will make the second edition even more valuable.

Charles Dailey

**STENOLECHIA BATHRODYAS MEYRICK, A RECENTLY
INTRODUCED PEST OF ORNAMENTAL CONIFERS
IN SOUTHERN COASTAL CALIFORNIA
(LEPIDOPTERA: GELECHIIDAE)**

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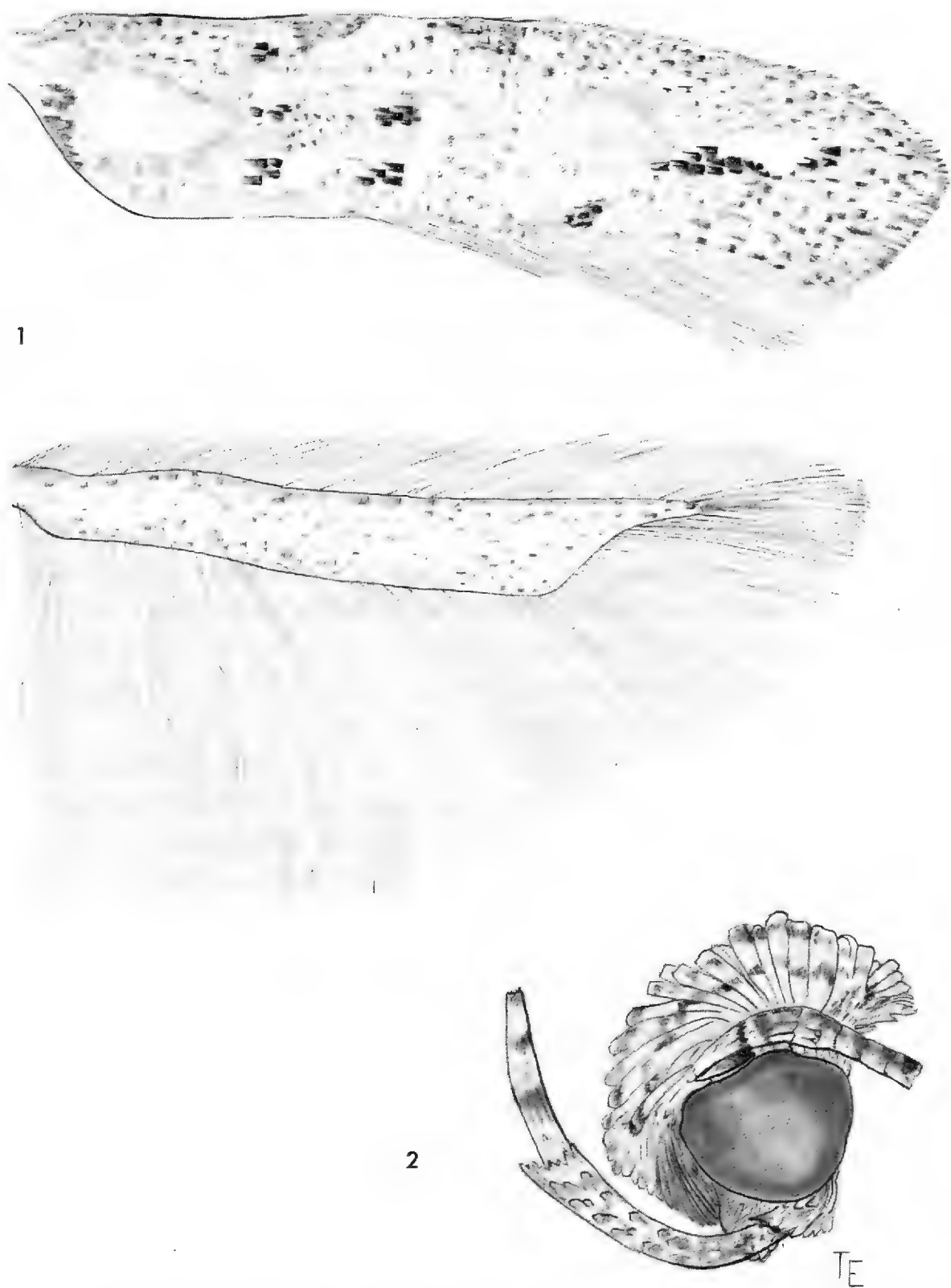
On July 31, 1969 a few adult specimens of a small gelechiid from Pacific Palisades, Los Angeles County, California collected on *Juniperus sabina* L. var. *tamariscifolia* Ait. (savin) were submitted to the Insect Taxonomy Laboratory in Sacramento for identification. Specimens from La Jolla, San Diego County on *Juniperus* sp. were sent to the laboratory on September 22, 1976. Following both submissions, specimens were referred to R. W. Hodges, Systematic Entomology Laboratory, U.S.D.A., Washington, D.C., who advised that it was a species unknown to him.

On February 28, 1977 and again on April 26, 1977, samples of *Cupressocyparis leylandii* (hybrid of Monterey cypress and Alaska cedar) and *Cupressus* sp. (CDFA rearing lots #133 and #141 respectively) from La Jolla were sent to Sacramento, with adults commencing emergence on March 28, 1977 and June 13, 1977 respectively. Adults were reared on August 31, 1977 from *Juniperus* sp. collected from Ventura, Ventura County.

On March 13, 1978 K. Sims submitted infested *Juniperus* spp. (Lot #154) from Pacific Beach and La Jolla with the comment that the insect had become an increasing problem in the past two years and was causing extensive damage. Adults from this material emerged in April. Sims also reported seeing similar damage to Italian cypress in the same areas (in litt.).

Infested juniper was forwarded from San Diego, July 20, 1978; several adults emerged in late August (Lot #165). The latest material received was a sample of larvae from a household planting of juniper in San Diego on February 20, 1980.

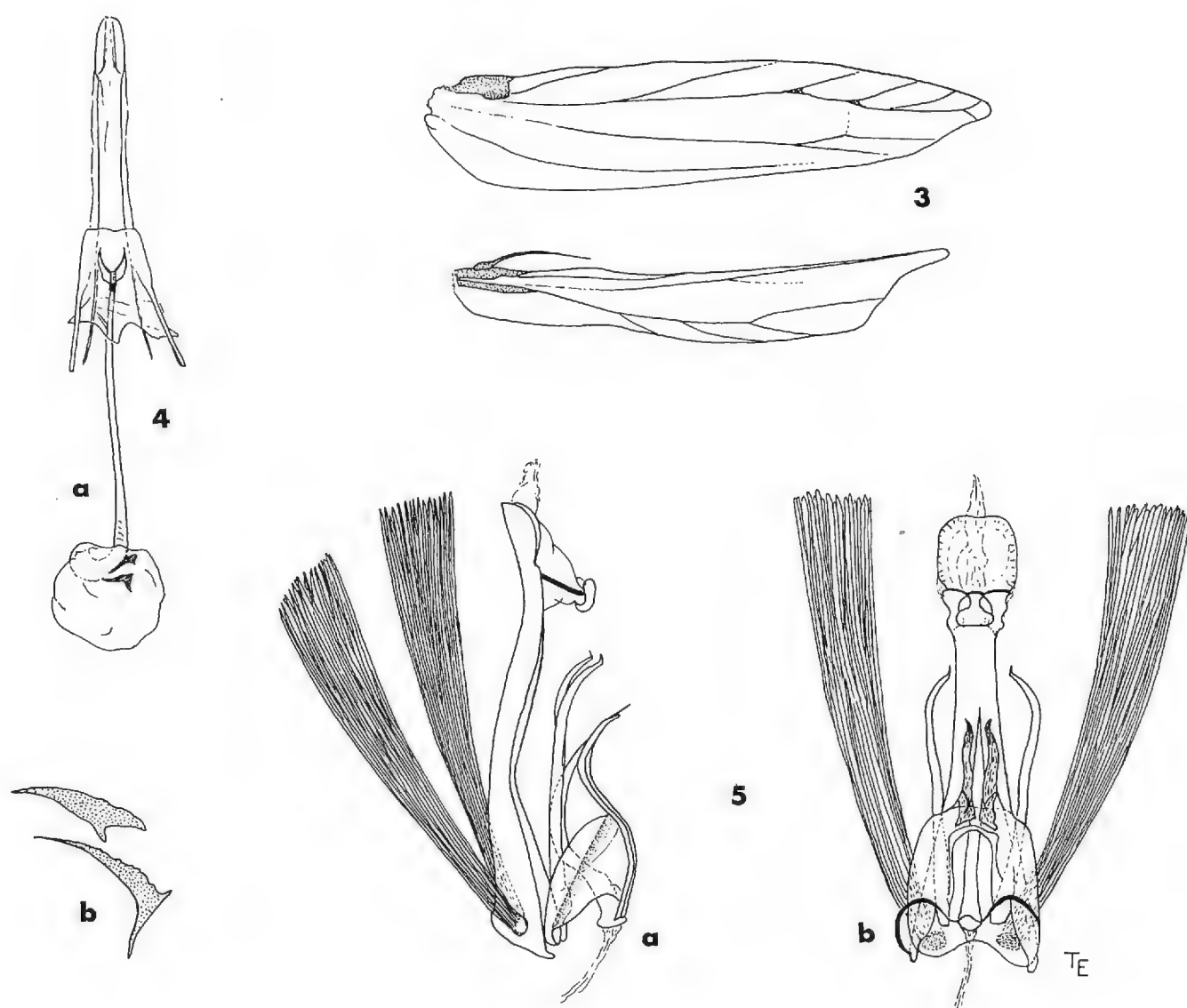
After prolonged inquiry and search, I found in Clarke (1969, pl. 193) illustrations of *Stenolechia bathrodyas* Meyrick, which were similar to California specimens in wing pattern, size, and male genitalic morphology. More detailed information was obtained from Okada (1962), including a host association with *Juniperus chinensis* (Antoine). Comparisons of the male genitalia with that of the type of *S. bathrodyas* and with drawings in Okada's paper confirmed that the two are conspecific or very near, the major difference being that the valva of the Japanese specimens appears to be relatively



Figs. 1–2. *Stenolechia bathrodyas*. Fig. 1, fore- and hindwing patterns. Fig. 2, head with scales, lateral view.

longer than in the California specimens. I have concluded that the valva length must be variable and that the California population has resulted by introduction of *S. bathrodyas* from Japan, probably on imported infested host material.

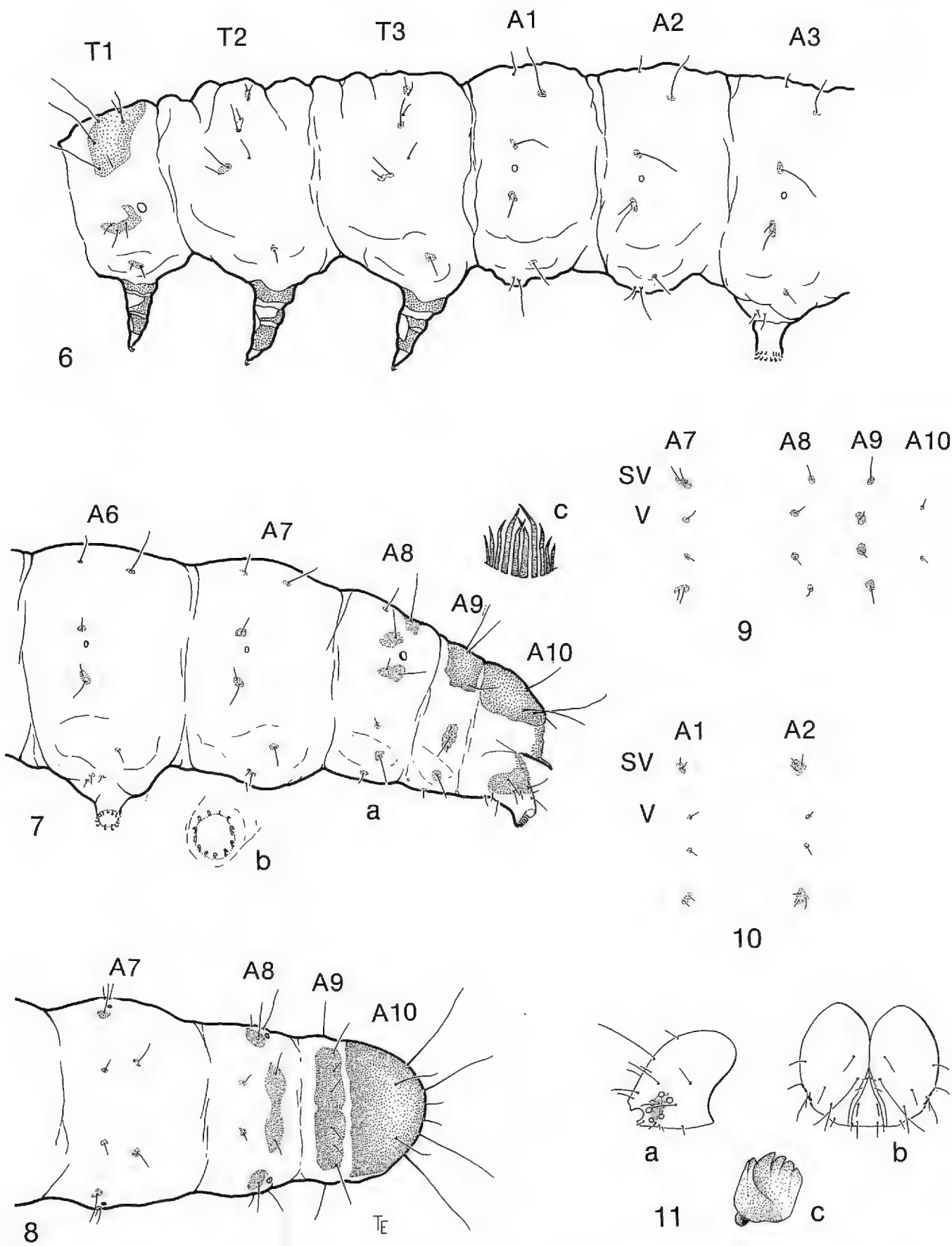
The discovery of this introduced pest resulted from the keen observations,



Figs. 3–5. *Stenolechia bathrodyas*. Fig. 3, venation of fore- and hindwings. Fig. 4a, female genitalia, ventral view; b, closeup view of signa. Fig. 5, male genitalia; a, lateral view; b, ventral view.

persistence and cooperation of K. Sims, San Diego County Department of Agriculture and V. Lazareo, County Farm Advisor, San Diego County. Thanks are extended to J. A. Powell, University of California, Berkeley and K. Sattler, British Museum (Natural History), London, for comparing types of Gelechiidae, and the latter for reviewing Meyrick's type of *Stenolechia bathrodyas*. I greatly appreciate the prompt cooperation of K. Yano, Yamaguti University, Japan. Translation services were provided by C. Lai, Plant Pathologist, and finishing touches were put on the illustrations by C. S. Papp, Entomologist; both of Laboratory Services, California Department of Food and Agriculture, Sacramento.

The following description is based entirely on specimens from the coastal California locations.



Figs. 6–11. Larva of *Stenolechia bathrodyas*. Fig. 6, thorax and A1–A3, lateral view. Fig. 7a, A6–A10, lateral view; b, closeup view of crochets; c, closeup, ventral view of anal comb. Fig. 8, A7–A10, dorsal view. Fig. 9, SV and V setal arrangement for A7–A10. Fig. 10, SV and V setal arrangement for A1 and A2. Fig. 11, larval head structures; a, lateral view; b, front view; c, mandible.

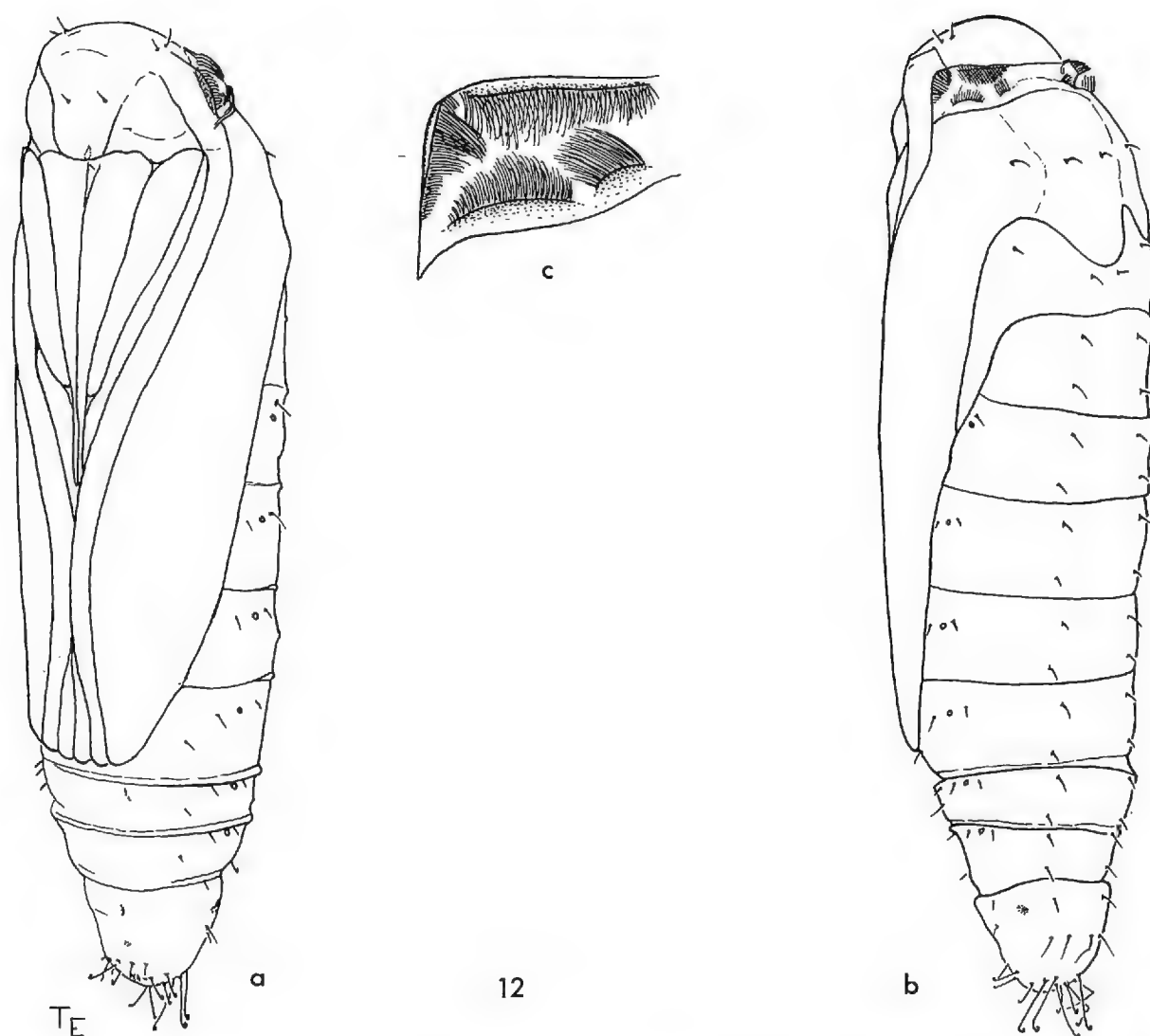


Fig. 12. Pupa of *Stenolechia bathrodyas*; a, lateroventral view; b, laterodorsal view; c, closeup of left side of pronotum.

Stenolechia bathrodyas Meyrick
(Figs. 1–12)

Adult.—Forewing length 2.8–3.0 mm. Head (Fig. 2): Light yellow-brown, some dark gray spotting on scales; front brown laterally and onto proboscis; labial palpus with first and second segments laterally mostly dark brown, third segment with two encircling dark brown bands; antenna with dark gray bands on each segment dorsally. Thorax yellow-brown with scales brown apically. Forewing (Fig. 1) mostly yellow-brown with many scales brownish apically, areas of white around most dark spots; several variable, dark gray, irregular spots as figured, with apical dash being largest. Hindwing pale gray with many dark gray-tipped scales; fringe paler. Venation as in Figure 3; some variation in degree of reduction of some veins among individuals. Abdomen light yellow-brown, lustrous; males with two pairs of long yellow-brown scale tufts (coremata) dorsally, one pair issuing from two eversible sacs near base of genital capsul and one pair on base of tegumen of genitalia.

Legs mostly dark gray with light yellow-brown at base and apex of segments; tarsi dark gray, ringed with light yellow-brown at joints; hindtibia with setaceous, light yellow-brown tuft along entire dorsal edge, spurs dark gray. Male genitalia (Fig. 5) and female genitalia (Fig. 4) as illustrated.

Larva (Figs. 6–11).—Mature living specimens 5.5–6.0 mm in length, generally green; head brownish yellow with dark area between ocelli (head dark on earlier instars); thoracic legs, prothoracic shield, most dorsal pinacula, and anal shield dark, contrasting. Abdominal segment nine dorsally with broad, dark, elongate sclerite including setae D1, D2 and SD1, varying from being slightly constricted to nearly divided along middorsal line; three lateral setae on common pinaculum. Abdominal segment eight with pinacula of D2 setae usually contiguous, forming elongate, irregular, dark sclerite; SD1 dorsoanterior to spiracle, with relatively large pinaculum; other pinacula small, paler. SV setal formula: 2,3,2,1,1 for those specimens examined. Crochets number approximately 10–14, uniordinal, arranged in a complete circle. Posterior region of larva minutely but fairly densely spinose; anal fork tortricoidlike with 10 prongs, the central pair being crossed apically, pairs of different lengths with shortest prongs laterally.

Pupa (Fig. 12) as illustrated, brownish yellow.—Length about 3 mm. Pronotum laterally with unusual area (Fig. 12c), consisting of medial concavity nearly surrounded by four, somewhat arched ridges of differing lengths, each thickly covered on dorsal edge with setaceous scales directed toward concavity; function unknown. No true cremaster but with several hooked setae of various lengths posteriorly.

Deposition of voucher specimens: British Museum (Natural History), London; California Department of Food and Agriculture, Sacramento; California Academy of Sciences, San Francisco; California Insect Survey, University of California, Berkeley; Los Angeles County Museum of Natural History; National Museum of Natural History, Washington, D.C.

Host plants.—Various species and hybrids of *Cupressus* and *Juniperus*.

Distribution.—Japan: Tokyo to Osaka (Esake et al., 1969). North America: California, Ventura to San Diego.

Biology.—The available collection data suggest there are at least three generations per year. This agrees with Osaka (1962), who states that the species in Japan is trivoltine with adults present in April, June and August into September. Larvae have been found in Japan in March, May and July. From the California localities, adults were reared out at approximately the same periods. The shortest duration for a single generation appears to be about 90 days, occurring during the warmer months.

The slow moving larva feeds through the leaves but apparently does not bore into the twigs, except perhaps in the growing tips. They migrate externally, leaving behind silk strands and producing webbing between twigs. Heavy infestation by this pest results in whole branches or sections of the

plant becoming brown, resembling the effects of some plant diseases. Pupae were found in very thinly prepared cocoons of silk, covered with frass, small wood chips and pieces of leaves at the juncture of two twigs, or the juncture of a twig and a branch, or concealed under an old leaf on a branch-let.

The genus *Stenolechia* Meyrick, until now, was found in central Europe, and eastern and southeastern Asia, where some species are known to be conifer feeders. For a comparison of the larval and pupal structures of the central European species, see Patočka (1977). In North America *Stenolechia* most closely resembles the genus *Recurvaria* Haworth. The two genera differ primarily in details of the genitalia and immature stages. At present, *S. bathrodyas* has not been detected in native stands of cypress or juniper, but only in ornamental plantings. This gelechiid would have to be considered a potentially destructive pest to native species and to nursery operations.

Literature Cited

- Clarke, J. F. G. 1969. Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick, Gelechiidae (D-Z), 7:1-531, plates 1-265. London, British Museum.
- Esaki, T., S. Issiki, A. Mutuura, H. Inoue, M. Ogata, H. Okagaki, and H. Kuroko. 1969. Icones Heterocerorum Japonicorum in Coloribus Naturalibus. Hoikusha, Osaka, Japan, i-xix + 318 pp, 64 pls. [46-47].
- Okada, M. 1962. On some Japanese gelechiid moths bred from coniferous plants. Pub., Ent. Lab., Univ. Osaka pref., No. 7:27-42, 81 figs.
- Patočka, J. 1977. Beitrag zur Kenntnis der Morphologie und Bionomie der mitteleuropäischen Vertreter der Gattung *Stenolechia* s.l. (Lepidoptera, Gelechiidae). Z. ang. Ent., 83:303-311.

BOOK REVIEW

John J. S. Burton. 1978. *Tabanini of Thailand above the Isthmus of Kra (Diptera: Tabanidae)*. Entomological Reprint Specialists, Los Angeles, 165 pages including 20 pages of 79 figures. \$15.00, hardbound.

The literature on Oriental Tabanidae is extensive but there are few organized studies of this economically important group of insects. An exception to this is Burton's study which included detailed personal collecting and observations over a period of many months, a review of older collections and a study of type material.

Although the area covered is only a limited portion of the Oriental Region, Burton's discovery of numerous new species gives some indication of what may be found elsewhere when similar detailed studies are made. Burton's book could well serve as a model for such studies.

The descriptions are detailed and presented in a well organized format and the supporting photographs of frontal and antennal characters are well done. Data on type series is complete with latitude and longitude given for most localities.

Of special interest is a section on collections made in the past and the relation of listed collection localities to present day geographic names. This should be of interest to all biologists interested in the fauna and flora of southeast Asia.

The book is well put together, printed on attractive off-white paper and apparently almost completely free of typographical errors. It is invaluable to anyone interested in Oriental Tabanidae.

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**YAMA TAHITIENSIS N. GEN., N. SP. FROM TAHITI
(DIPTERA: CHIRONOMIDAE)**

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The chironomids of Tahiti are known only from a brief report by Edwards (1933). In collecting on Tahiti the junior author reared several examples of a heretofore undescribed genus and species, closely related to *Chironomus*, from the buttress pools of the tahitian chestnut, *Inocarpus edulis*. In company with the undescribed chironomid were two mosquitoes, *Aedes polynesiensis* Marks and *Culex roseni* Belkin. There was also an unidentified ostracod present.

Mature larvae were isolated in shell vials to which a small amount of aquarium water was added. The capped vials were allowed to stand until the fourth instar larva transformed or died. Several, as indicated under paratypes, completed metamorphosis.

Several mature larvae were fixed in a 3:1 solution of ethyl alcohol-acetic acid and subsequently examined cytologically. Chromosome squash preparations were made following the procedure outlined by Wülker et al. (1971).

Material for scanning electron microscopy was chemically dehydrated through a series of ethyl alcohol and toluene mixtures. Specimens were positioned on examination stubs with double sticky tape and subsequently vacuum coated with gold-palladium.

Scanning electron microscopy was done with an ETEC Stereoscan microscope at 10 KV accelerating voltage.

Morphological terminology follows Hirvenoja (1973) and Hansen and Cook (1976), except that we have used dorsomedial for acrostical setae and dorsolateral for dorsocentral setae. The ocular ratio is the ratio of the width between the dorsal eye extensions divided by the greatest head width.

Cytological nomenclature follows Keyl and Keyl (1959).

We should like to thank Dr. Robert E. Waterman, Department of Anatomy, University of New Mexico School of Medicine, for making the scanning electron microscopy facilities available to us and for assisting with

technical problems in machine operation. We are also indebted to Mary Sublette for assistance in preparation of illustrations and the manuscript. The senior author was supported by a faculty research grant from Eastern New Mexico University, and the junior author by a travel grant from the University of Melbourne.

Yama, new genus

Etymology.—Word formed as an arbitrary combination of letters.

Gender.—Feminine.

Type-species.—*Yama tahitiensis* n. sp. monotypic.

Imago.—*Head*.—Antenna of male with 12 flagellomeres, female with 5. Palpi long and slender, only slightly shorter than the male flagellum (palpus length, 0.097, flagellum length, 1.02 mm). Small frontal tubercles present. Dorsal extension of eye broad and parallel-sided. Clypeus almost square, not projecting. Temporal setae in a complete series from behind the eye to above the dorsal apex of the eye.

Thorax.—Anteprenotum anteriorly with a broad, gaping notch. Mesoscutum with a median hump.

Wing.—Membrane with coarse microtrichia. R_{4+5} ends about over M. R_{2+3} closely parallels R_1 for most of its length then diverges slightly near the apex. Fork of the cubitus ends slightly distal to r-m. Anal lobe right-angled. Squama fully fringed.

Legs.—Fore tibia with a low rounded scale. Middle and hind tibial combs slightly overlapping, each pair with two spurs subequal in length. Pulvilli over half as long as the claws. Foreleg ratio greater than 1.0.

→

Fig. 1. a, Head in lateral view showing frontal tubercles (arrow) and temporal setae. SEM, 330 $\times$. b, Frontal tubercle showing apparent trichoid sensilla at the apex. SEM, 3000 $\times$. c, Anteprenotum. Note the postpronotal scar immediately posterior to the anteprenotum. SEM, 200 $\times$. d, Wing margin. The fluted marginal setae are in two series and the coarse microtrichia cover the wing surface. SEM, 2000 $\times$. e, Postpronotal scar. SEM, 800 $\times$. f, Postpronotal scar. SEM, 1200 $\times$.

Fig. 2. a, Foretibial apex. SEM, 500 $\times$. b, Mesotibial spurs, apical view. SEM, 625 $\times$. c, Pulvillus and claw, lateral view. SEM, 1640 $\times$. d, Base of pulvillus and unguitractor (arrow). Note overlapping plates at base of pulvillus. SEM, 3200 $\times$. e, Male genitalia, dorsal view. SEM, 150 $\times$. f, Male genitalia, ventral view. Note apical lobe of gonocoxite devoid of microtrichia. SEM, 150 $\times$.

Fig. 3. a, Superior appendage of male genitalia, dorsal view. SEM, 570 $\times$. b, Larval head capsule, dorsal view. SEM, 100 $\times$. c, Larval antenna. SEM, 1625 $\times$. d, Larval antenna. Note campaniform sensilla at tip of accessory blade (arrow). SEM, 2000 $\times$. e, Lauterborn organ. SEM, 4800 $\times$. f, Apex of labial plate. SEM, 860 $\times$.

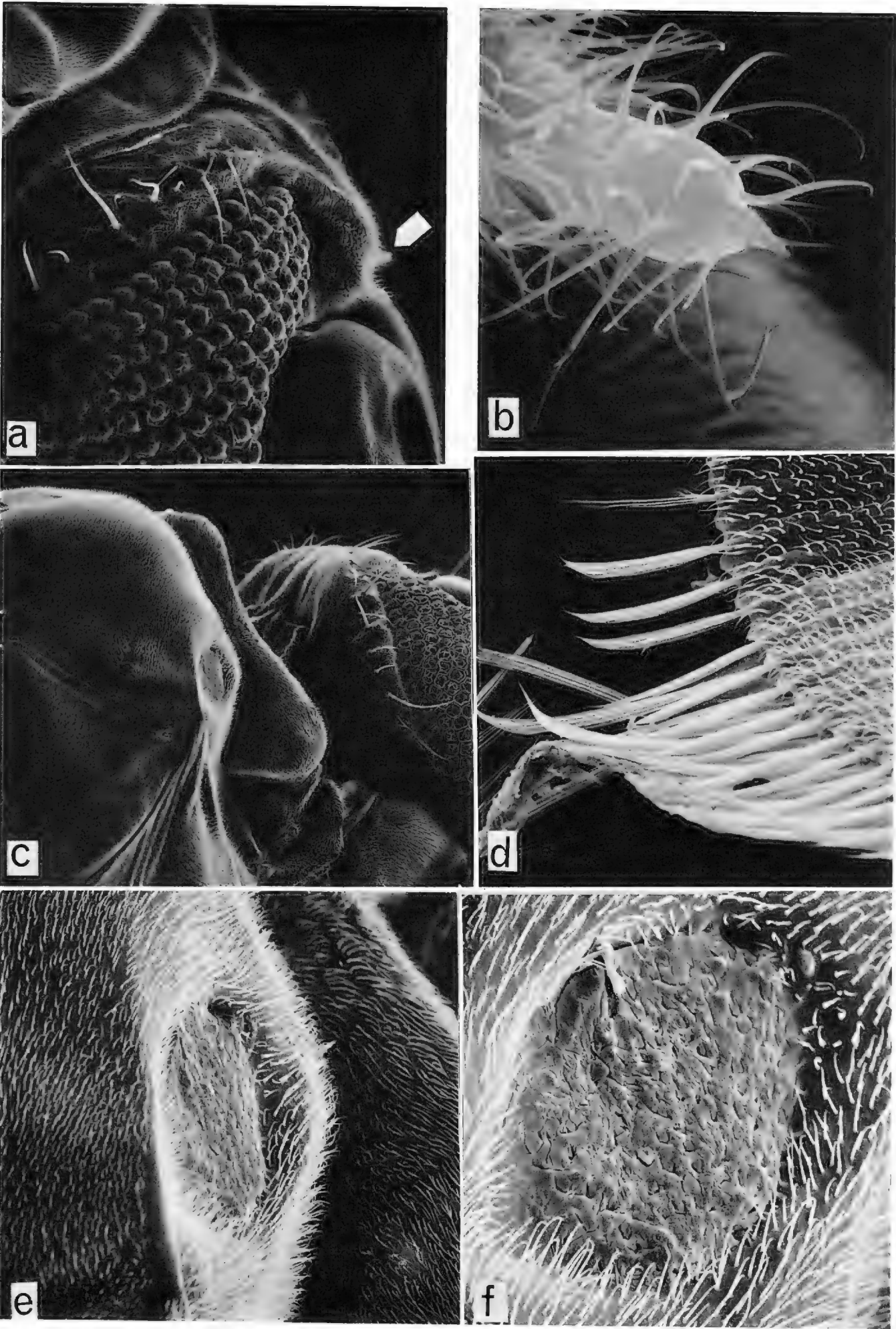


FIGURE 1.

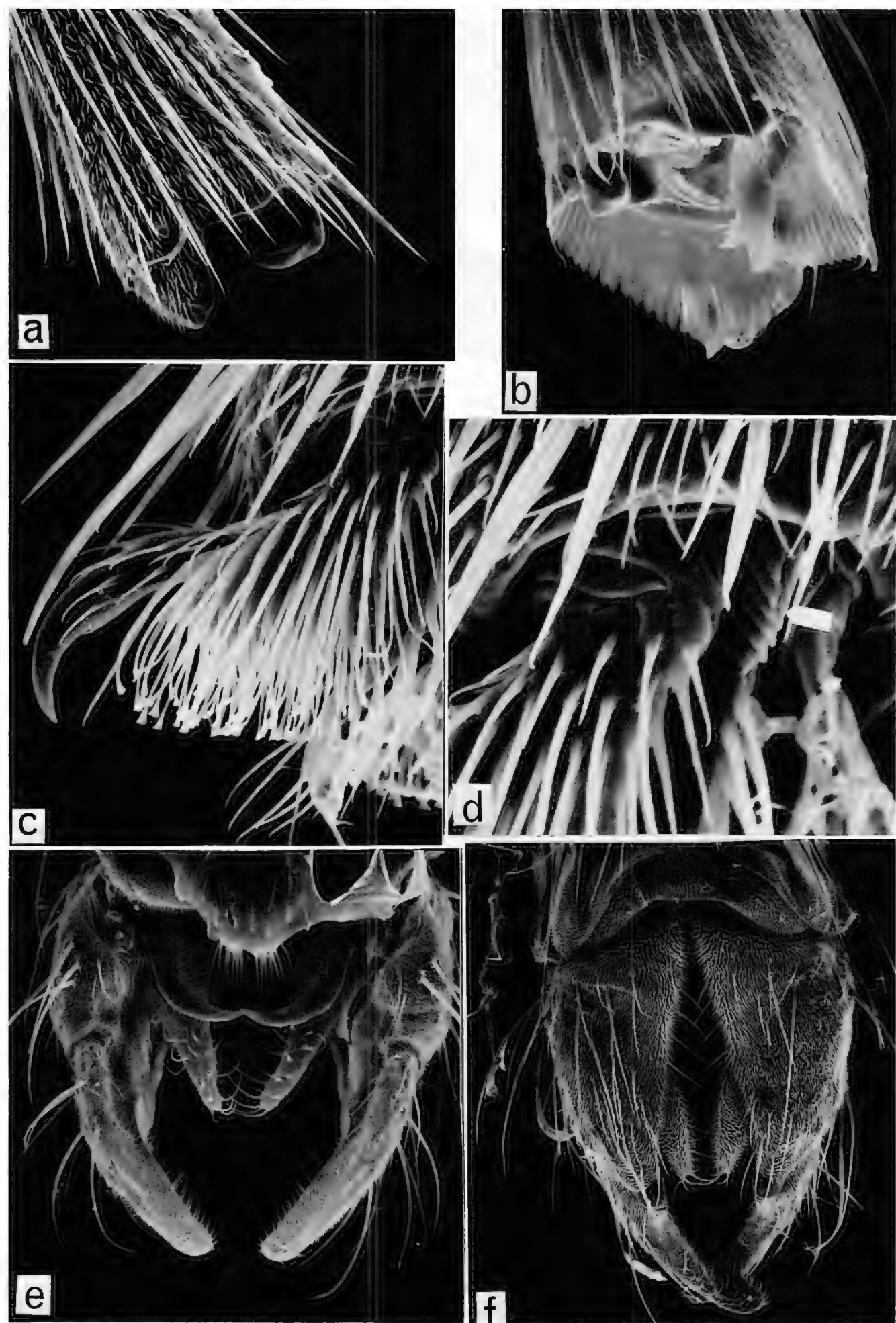


FIGURE 2.

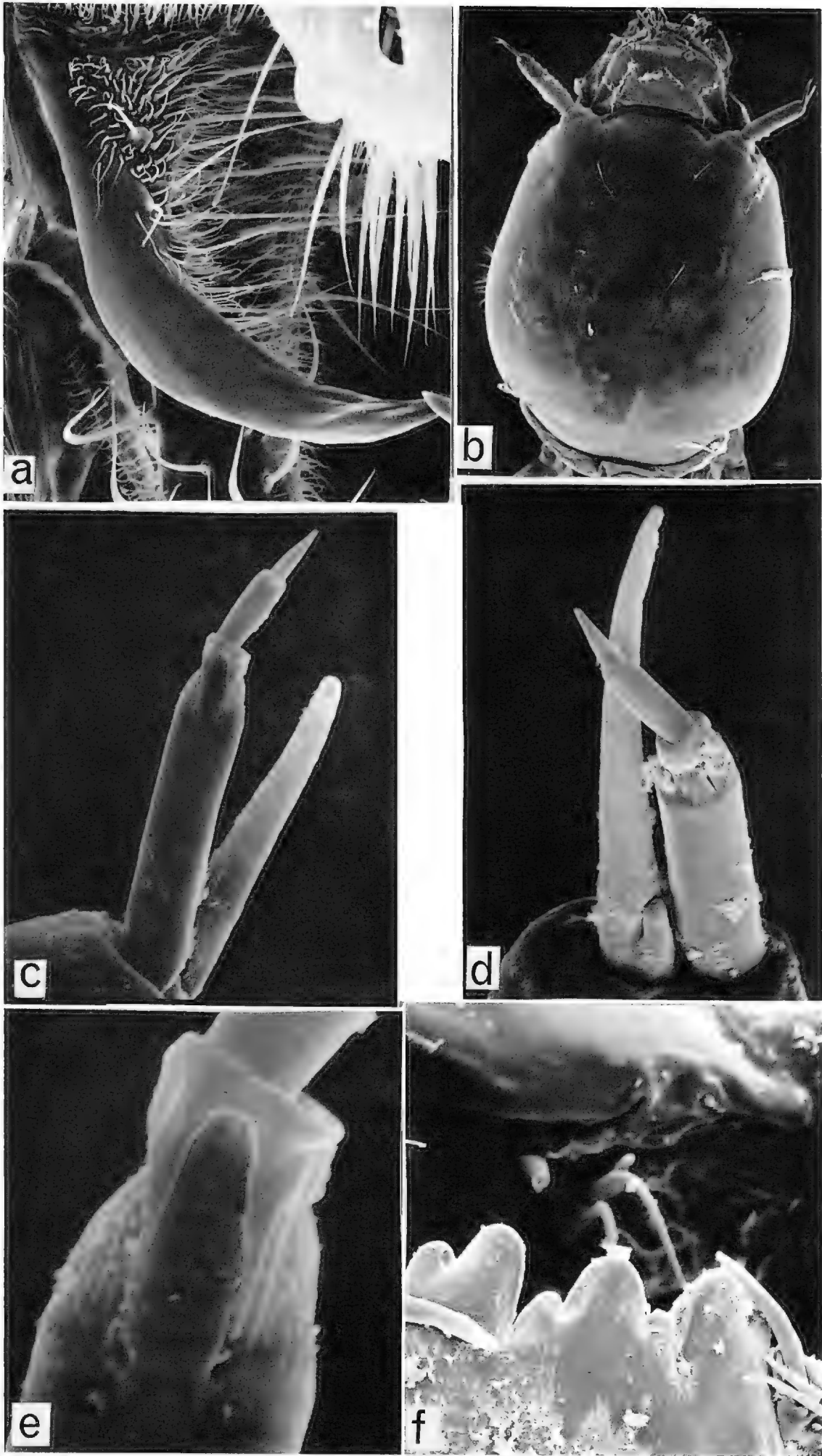


FIGURE 3.

Genitalia.—Anal point lacking; ninth tergum with two setose tubercles, one on each side of the midline. Superior appendage (SA) elongate and hooked, without a basal lobe, and with several setae beyond the base.

Larva.—Similar to *Chironomus* but without ventral tubuli. Other features, see description which follows.

Pupa.—Also similar to *Chironomus* but with the recurved hook row at the apex of tergum II interrupted at the midline.

Diagnosis.—Among the Chironomini relatively few genera lack an anal point. The presence of a low rounded fore tibial scale, the lack of ventral appendages on the male genitalia, and the slender, hooked superior appendage with several setae beyond the base, are distinctive for this genus.

Yama tahitiensis n. sp.

In the collection of the U.S. National Museum. Papeari, Tahiti Botanical Gardens, male reared from pupa collected in buttress root pools of *Inocarpus edulis*, 21-XI-1974, Jon Martin.

Holotype male.—Coloration. Ground color of head, thorax, and abdomen yellowish-green; mesoscutal vittae blackish brown, apex of scutellum and venter of preepisternum dark brown; legs marked with blackish brown as follows: narrow apex of all femora, broad base of fore tibia, narrow base of middle and hind tibiae, narrow apices of all tibiae, apex of all basal tarsomeres, tarsomeres 2–5 on all legs; 8th tergum and genitalia infusate.

Head.—Antennal ratio 1.65. Palpal proportions 0.051:0.255:0.235:0.331 mm. Length of frontal tubercles 0.02 mm; apex with the tip attenuate, Figs. 1a, b. Dorsal extension of eye broad and parallel-sided, 6 facets wide near apex. Ocular ratio 0.17. Clypeus almost square, 0.80 the width of the antennal pedicel; with 16 setae. Temporal setae 18, in a single staggered row, reaching distal to the dorsal apex of the eye, Figs. 1a, c. Tentorium Fig. 7b.

Thorax.—Anteprenotum Fig. 1c, anteriorly with a broad gaping notch; laterally with 2 setae. Postpronotal scar, Figs. 1e and 1f. The structure is interpreted as the scar of the point of attachment of the pupal respiratory organ. Dorsolateral setae 10, in a partially doubled row. In some of the paratypes the most anterior seta is far forward and separated from the remainder by a distinct gap. Dorsomedial setae 14, in a single row which is staggered posteriorly; near the posterior end of the row is a distinct hump in the mesoscutum; at least one of the setae on the hump is slightly inflated and bent (Fig. 7c). Prealar setae 6; supra-alar seta 1. Scutellum with a staggered posterior row of 12, mostly coarse setae; anteriorly with a staggered row of 7 finer setae.

Wing.—Membrane with coarse microtrichia visible at 100 $\times$, Fig. 1d. Wing margin with fluted setae (Fig. 1d). R with 34 setae along entire length, R₁ with 26 setae along entire length, R₄₊₅ with 34 setae on the apical two-thirds.

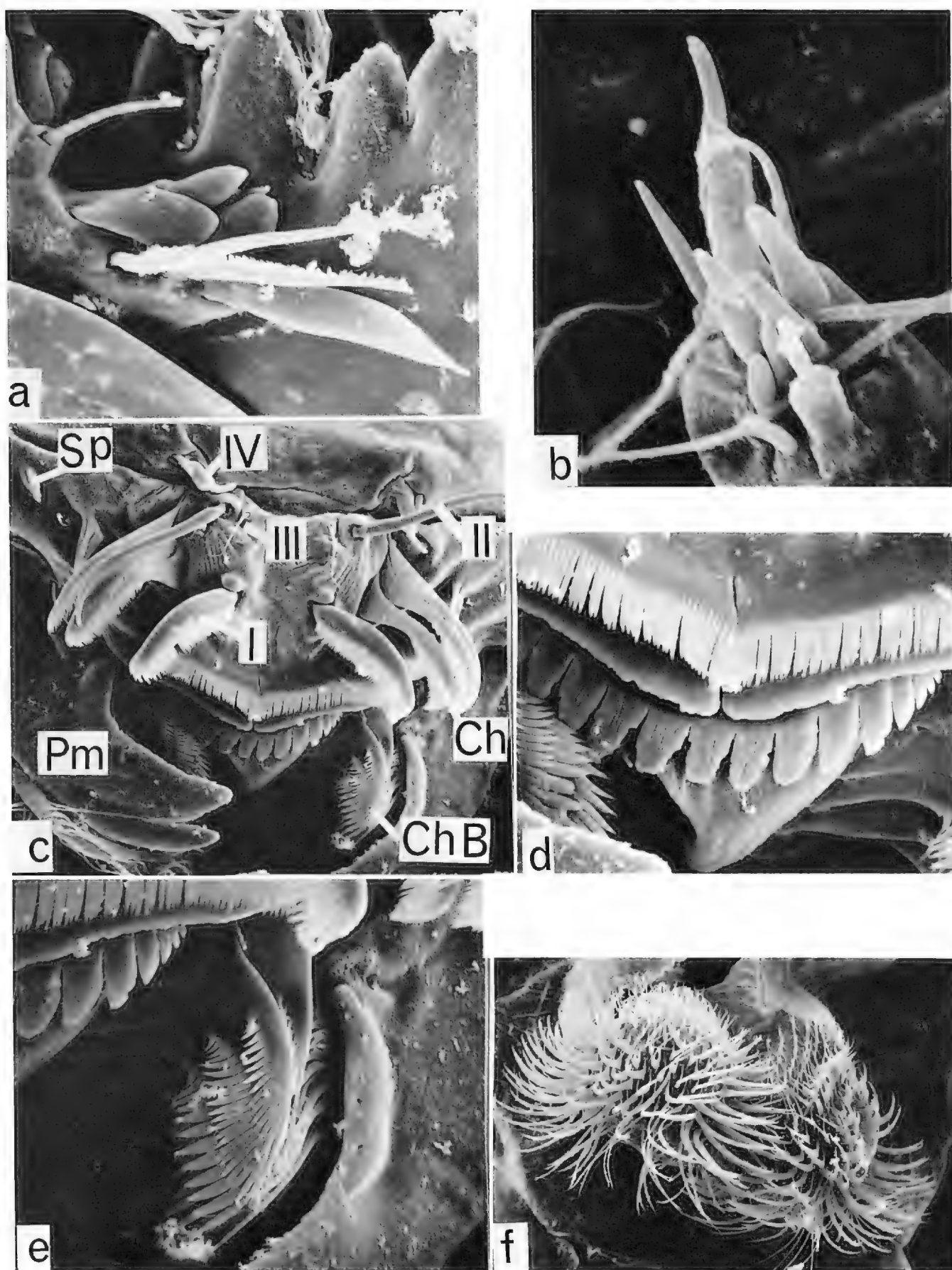


Fig. 4. a, Lacinia of maxilla. Note smooth margin of paralabial plate below. SEM, 1550 $\times$. b, Maxillary palpus. At least 10 sensilla are visible on the palpus apex. SEM, 3000 $\times$. c, Ventral labral structures. S I-IV, sensilla I-IV; Pm, premandible (torma); Ch, Chaetae; Sp, spinulae; ChB, Chaetulae basales. SEM, 840 $\times$. d, Pecten labralis (above) and pecten epipharyngis (below). SEM, 2240 $\times$. e, Chaetulae basales. SEM, 2240 $\times$. f, Anterior prolegs. SEM, 200 $\times$.

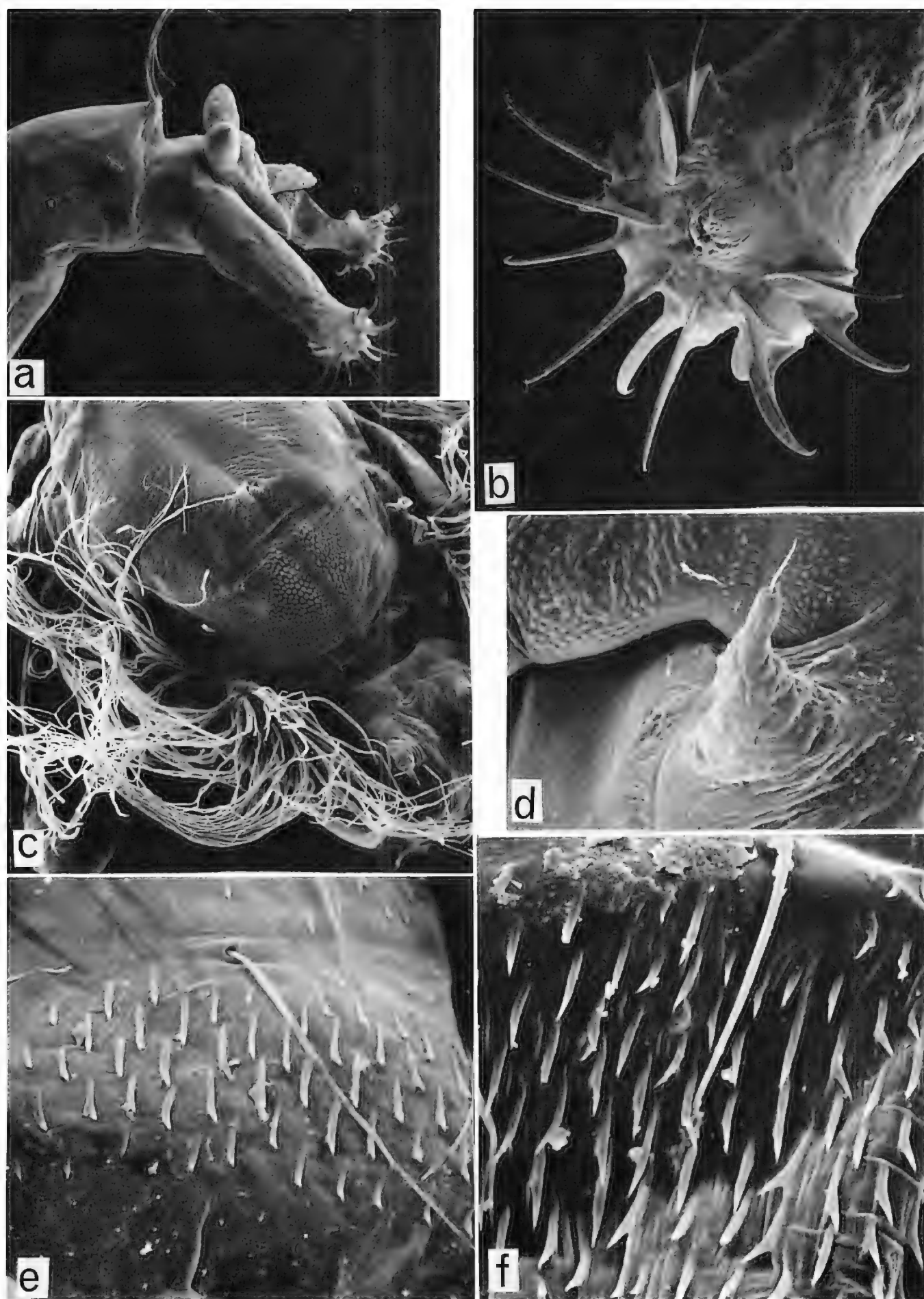


Fig. 5. a, Anal prolegs and anal tubuli. SEM, 60 $\times$. b, Posterior proleg. SEM, 260 $\times$. c, Pupal cephalothorax showing respiratory organs. SEM, 40 $\times$. d, Cephalic tubercle of pupa. SEM, 240 $\times$. e, Apical chagrin of tergum IV. SEM, 400 $\times$. f, Apical chagrin of tergum VI. SEM, 400 $\times$.

R₄₊₅ ends over the apex of M. R₂₊₃ closely parallels R₁ for most of its length then diverges slightly near the tip. Anal ends at 0.20 of the distance between f-Cu and the apex of Cu₂. Anal lobe right angled. Venarum ratio, 1.07. Wing length, 2.50 mm. Squama with 10 marginal setae.

Legs.—Foretibia with a low rounded apical scale, Fig. 2a. Middle and hind tibial combs slightly overlapping, each comb with a short spur of about equal length (Fig. 2b). Pulvilli over half as long as the claws, Fig. 2c. Base of pulvillus with a series of overlapping plates, Fig. 2d. Leg proportions:

	F	Ti	Ta ₁	Ta ₂	Ta ₃	Ta ₄	Ta ₅	Leg Ratio	Beard Ratio
Fore	85	65	103	52	43	40	17	1.58	1.56
Middle	84	75	40	22	17	10	6	0.53	1.76
Hind	90	86	53	28	23	14	7	0.62	2.22

Genitalia.—Figs. 2e, 2f, and 7a. Ventral apex of gonocoxite produced as a lobe devoid of microtrichia (Fig. 2f); gonostylus short, with short, heavy, medial setae (Fig. 2e). Superior appendage elongate, without a basal lobe; with several setae beyond base (Fig. 3a). Inferior appendage apically attenuate (Figs. 2e, f). Hypopygial ratio, 1.09.

Diagnosis.—The genitalia with the bituberculate ninth tergum lacking an anal point are distinctive among the Chironominae.

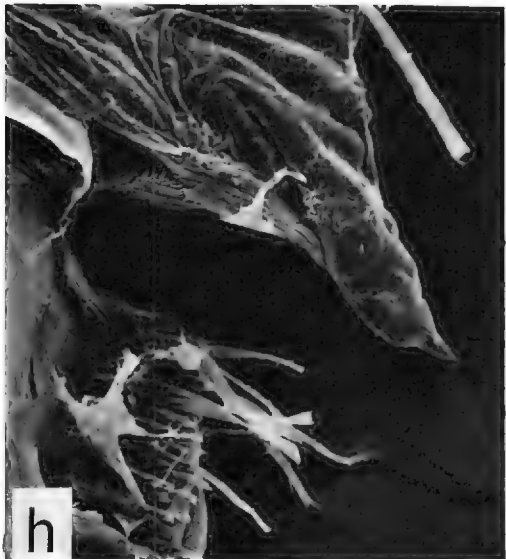
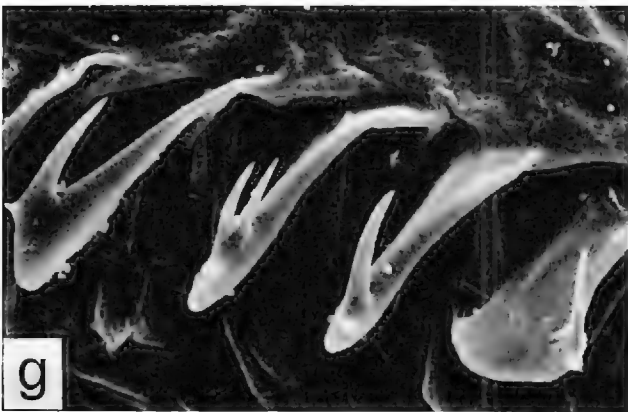
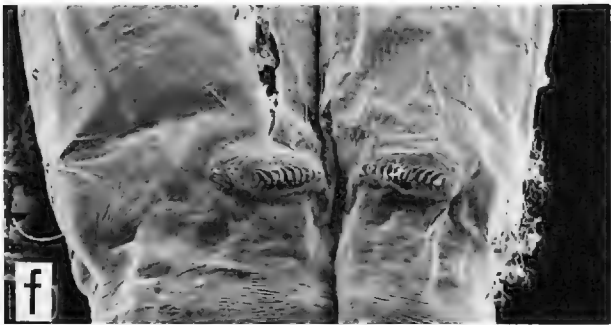
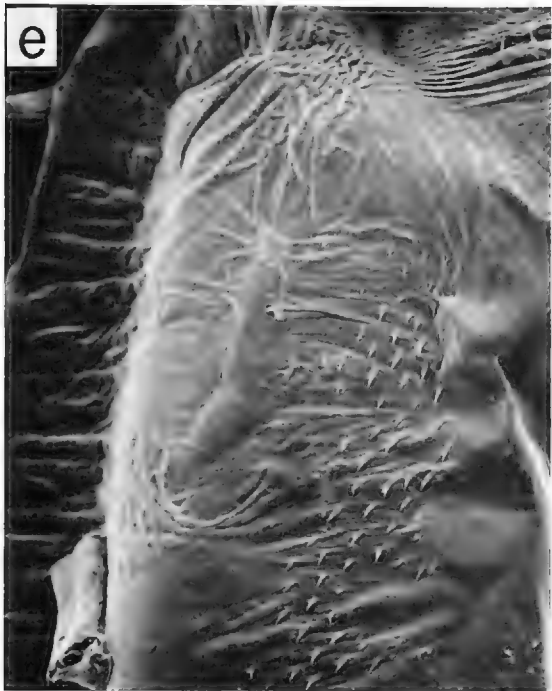
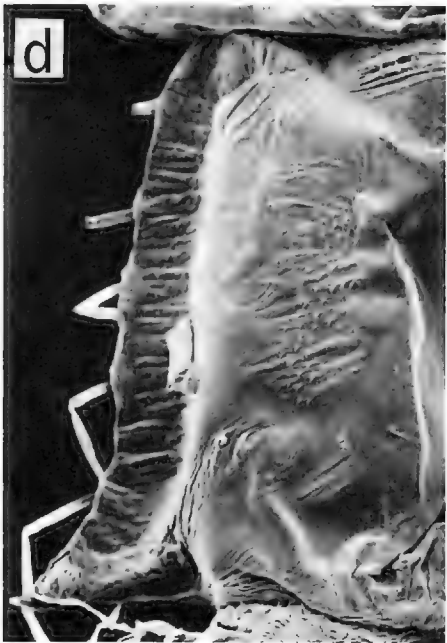
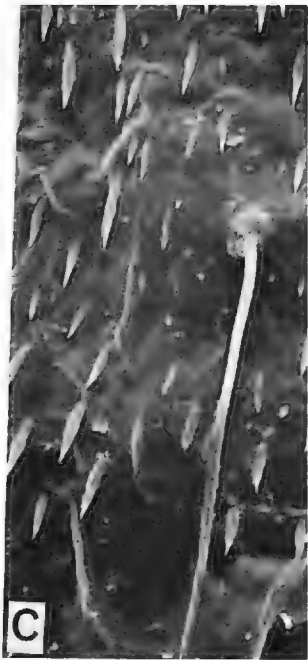
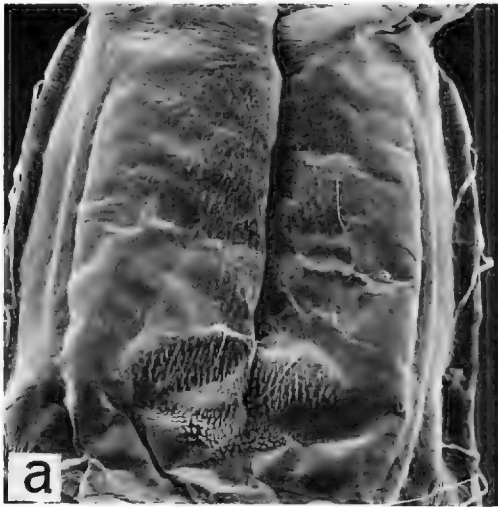
Allotype female.—Reared from a pupa collected with that of the holotype male. In the collection of the U.S. National Museum.

Coloration.—More darkly colored than the male, with the basal half of each abdominal tergum covered with a dark vitta; entire abdomen tinged with dark green (faded in slide mount); fore and middle tibiae almost entirely dark; basal tarsomere of the fore and middle tarsi with only the basal one-third pale; basal tarsomere of hind tarsus with the basal half pale.

Head.—Antennal proportions, 0.20:0.11:0.12:0.12:0.25 mm; length of antenna, 0.816 mm. Ocular ratio 0.13. Clypeus with 29 setae. Temporal setae 14, mostly in a single row becoming doubled above the dorsal apex of the eye. Palpal proportions, 0.56:.275:.275:.459 mm. Length of frontal tubercles, 0.018 mm.

Thorax.—Anteprenotum similar to the male; laterally with 1 seta. Mesoscutum with a distinct median hump. Dorsolateral setae 15, in a partially doubled row near the center; anteriorly the row extends to the level of the pupal respiratory scar. Dorsomedial setae 12, long and erect, mostly in a single row. Prealar setae 6; supra-alar seta 1. Scutellum with a staggered posterior row of 11 setae; anteriorly with 9 finer setae in a secondary, staggered row.

Wing.—Similar to the male. Membrane with coarse microtrichia visible at 100×. R with 36 setae along entire length. R₁ with 31 setae along entire



length; R_{4+5} with 4 setae on the distal four-fifths. Anal ends at 0.34 of the distance between f-Cu and the apex of Cu_2 . Anal lobe obsolete, only slightly less than right-angled. Venarum ratio, 1.09. Wing length, 2.51 mm. Squama with 11 marginal setae.

Legs.—Similar to the male except for color differences. Leg proportions:

	F	Ti	Ta ₁	Ta ₂	Ta ₃	Ta ₄	Ta ₅	Leg Ratio
Fore	88	65	104	55	45	42	16	1.60
Middle	85	78	40	21	16	10	7	0.51
Hind	92	90	56	30	25	14	8	0.62

Genitalia.—Fig. 8a.

Paratypes.—16 males with associated pupal exuviae, 3 females with associated pupal exuviae, 2 males with associated larval and pupal exuviae, 3 pupae (female), 3 pupae (male), 1 female, 7 pupal exuviae, 6 larvae, 2 larvae with associated squash preparations, collected with holotype; 2 males with associated larval and pupal exuviae, 3 larvae with associated squash preparations from the same locality, 20-II-1971, Jon Martin (paratypes deposited in the collections of the California Academy of Science, Bishop Museum and the senior author).

Paratype males.—Antennal ratio 1.37–1.71 (5); temporal setae 10–16 (5); ocular ratio 0.15–0.21 (4); ratio of clypeus width to width of antennal pedicel 0.73–0.76 (3); clypeal setae 14–25 (5).

Wing.—Length, 2.31–2.40 mm (3); venarum ratio 1.05–1.08 (4); squamal setae 6–9 (3); R setae 33–39 (3); R_1 setae 23–31 (3); R_{4+5} setae 26–28 (3).

Leg ratios.—Fore 1.48–1.53 (5); middle 0.49–0.53 (5); hind 0.60–0.64 (5).

Anteprenotal setae 0–1 (5); dorsomedial setae 10–14 (5); dorsolateral setae 9–11 (5); prealar setae 4–5 (5); scutellar setae 12–18 (5).

Larva.—Head capsule, Fig. 3b, pale except for a narrow occipital margin and the hypostomial plate. Ventral head length, 0.27–0.31 mm (4). Antenna, Figs. 3c, d, e. Antennal length, 0.16 mm (1); proportions: 100:20:3:5:4. Apex of labial plate, Fig. 3f, with 12 teeth on each side lateral to the central trifold tooth. Paralabial plate with smooth free margin, Fig. 4a; internally with about 24 coarse striae. Lacinia of maxilla, Fig. 4a; palpus, Fig. 4b. Ventral

←
Fig. 6. a, Tergum VI showing chagrin pattern characteristic of terga III–VI. SEM, 60×. b, Tergum VII showing chagrin pattern. SEM, 80×. c, Basal chagrin of tergum VII. SEM, 480×. d, Tergum VIII showing restricted chagrin. SEM, 100×. e, Basal chagrin of tergum VIII. SEM, 200×. f, Tergum II, posterior end, showing interrupted posterior hook row. SEM, 60×. g, Hooks of posterior row on tergum II. SEM, 1000×. h, Posteriolateral spur of segment VIII. SEM, 200×.

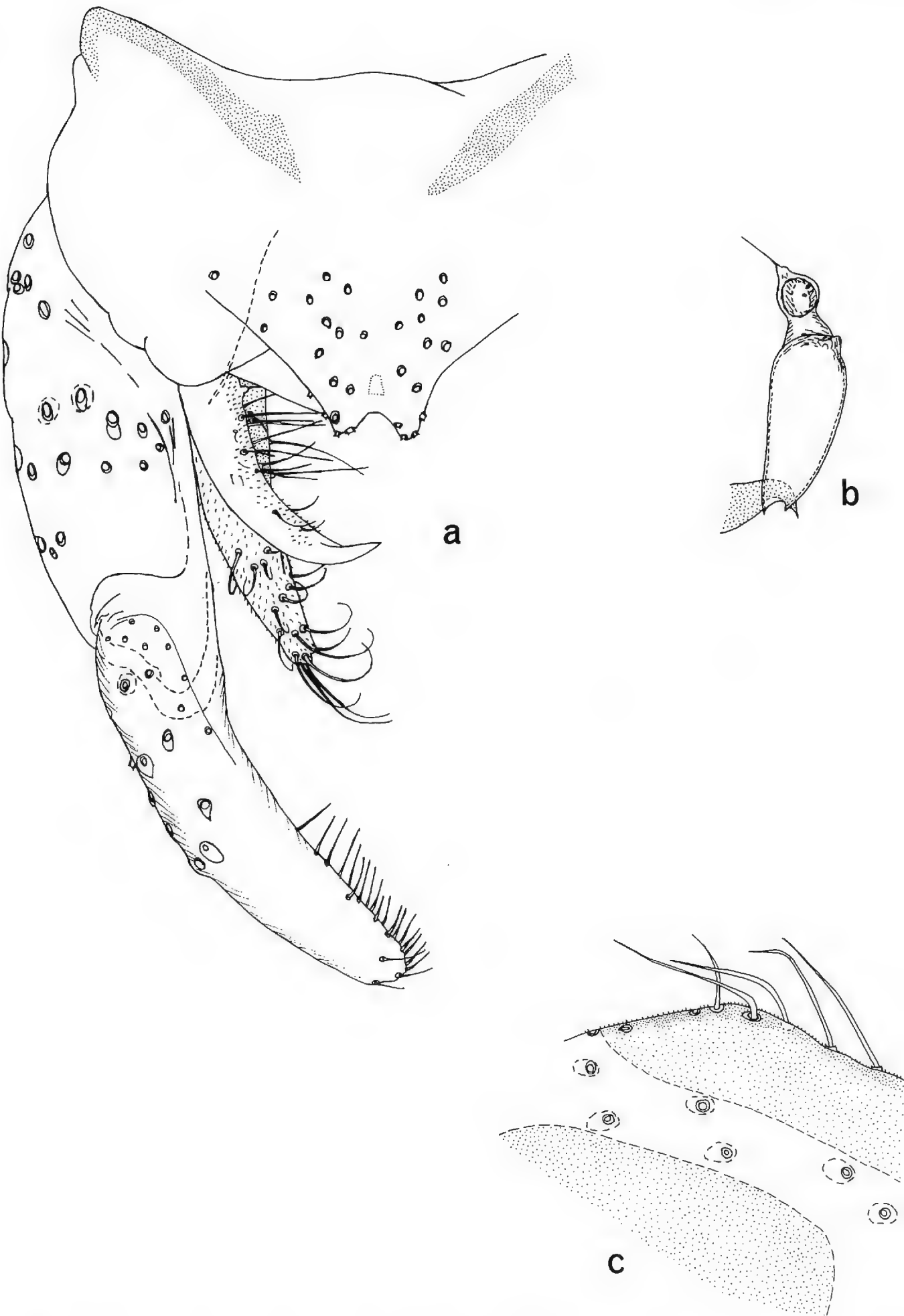


Fig. 7. a, Male genitalia, holotype male. b, Tentorium, holotype male. c, Mesoscutum, lateral view, showing inflated and bent dorsomedial setae on the hump.

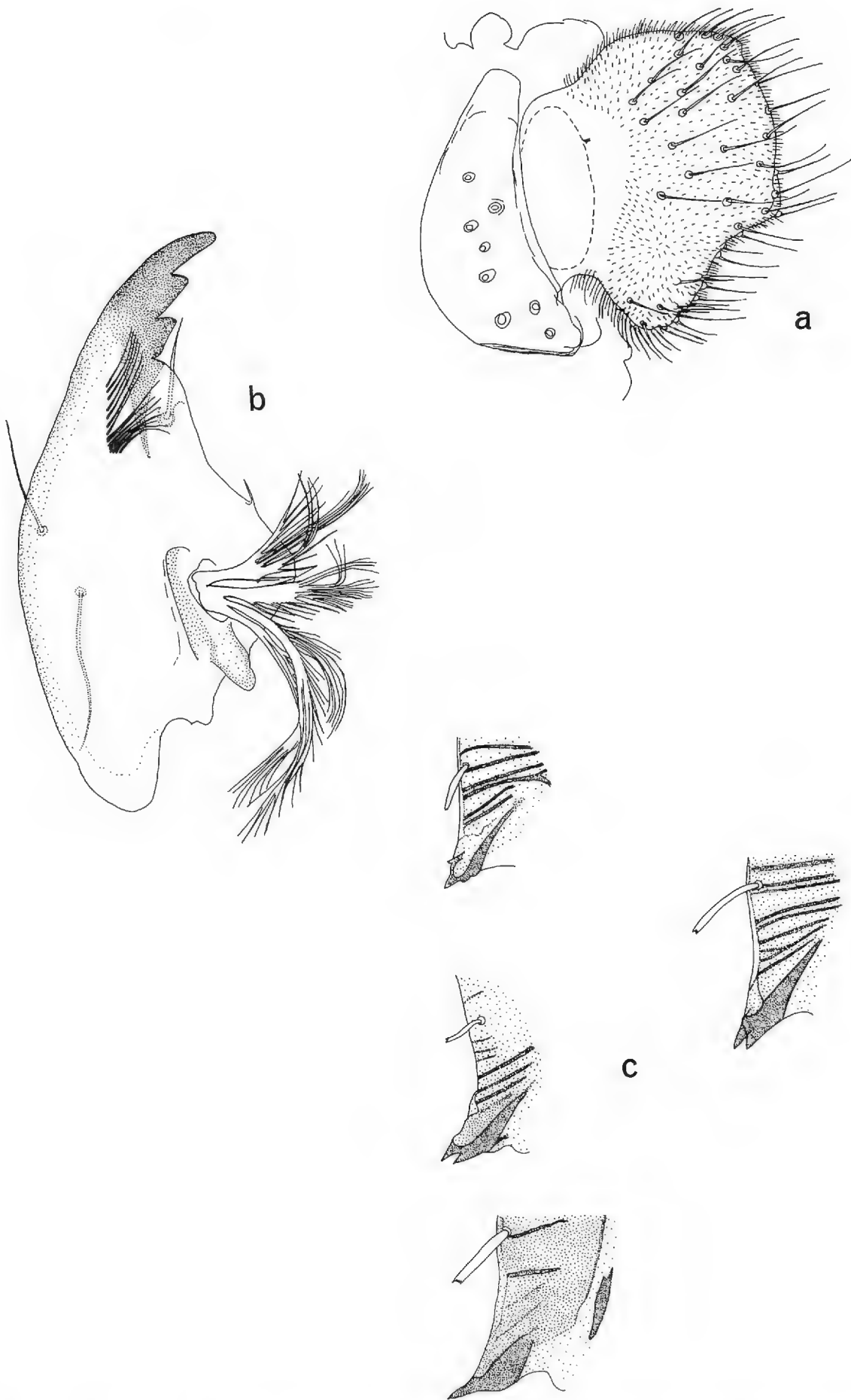


Fig. 8. a, Female genitalia, lateral view. b, Larval mandible. c, Variations in postero-lateral spurs of tergum VIII.

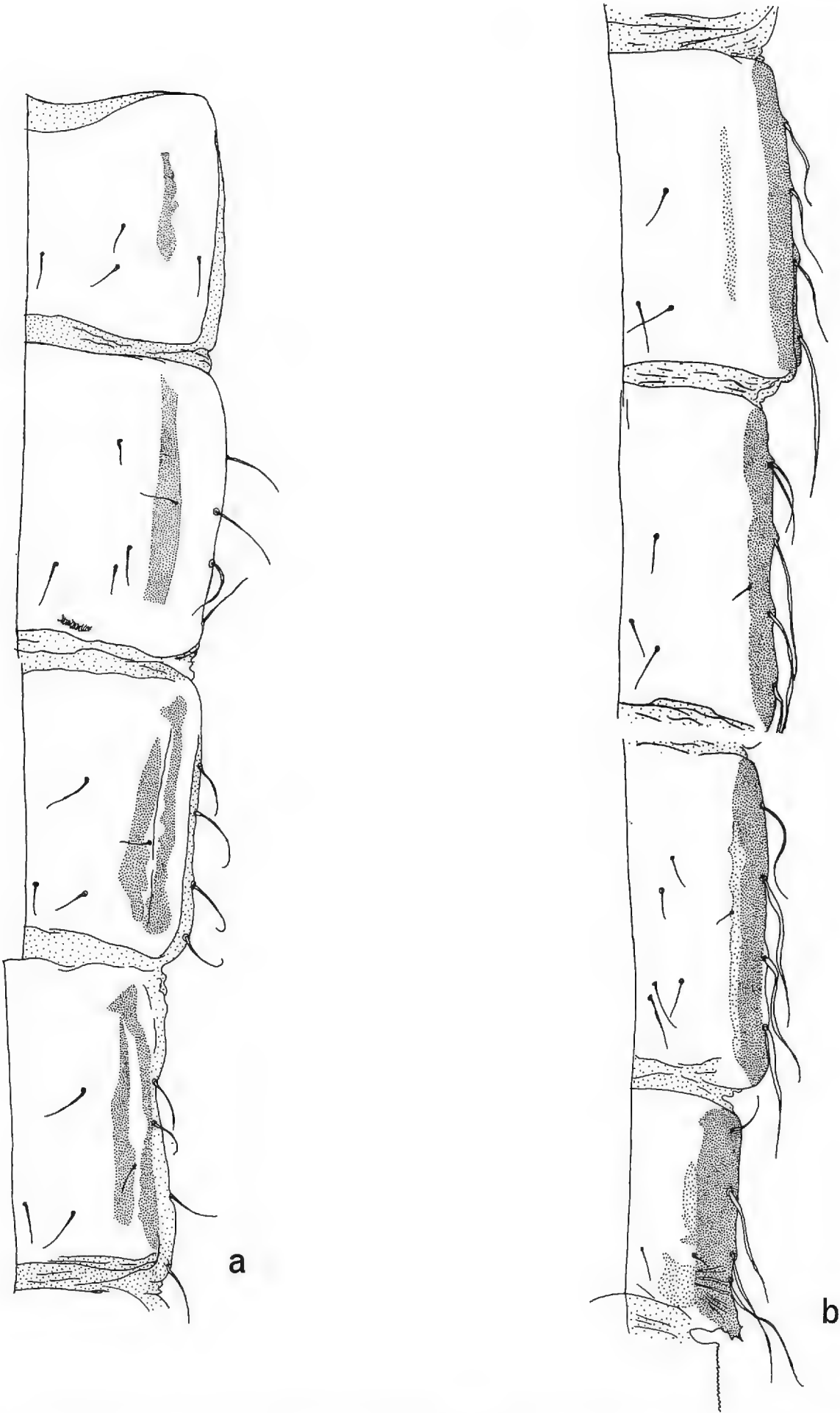


Fig. 9. a, Chaetotaxy and color pattern of terga I-IV. b, Chaetotaxy and color pattern of terga V-VIII.

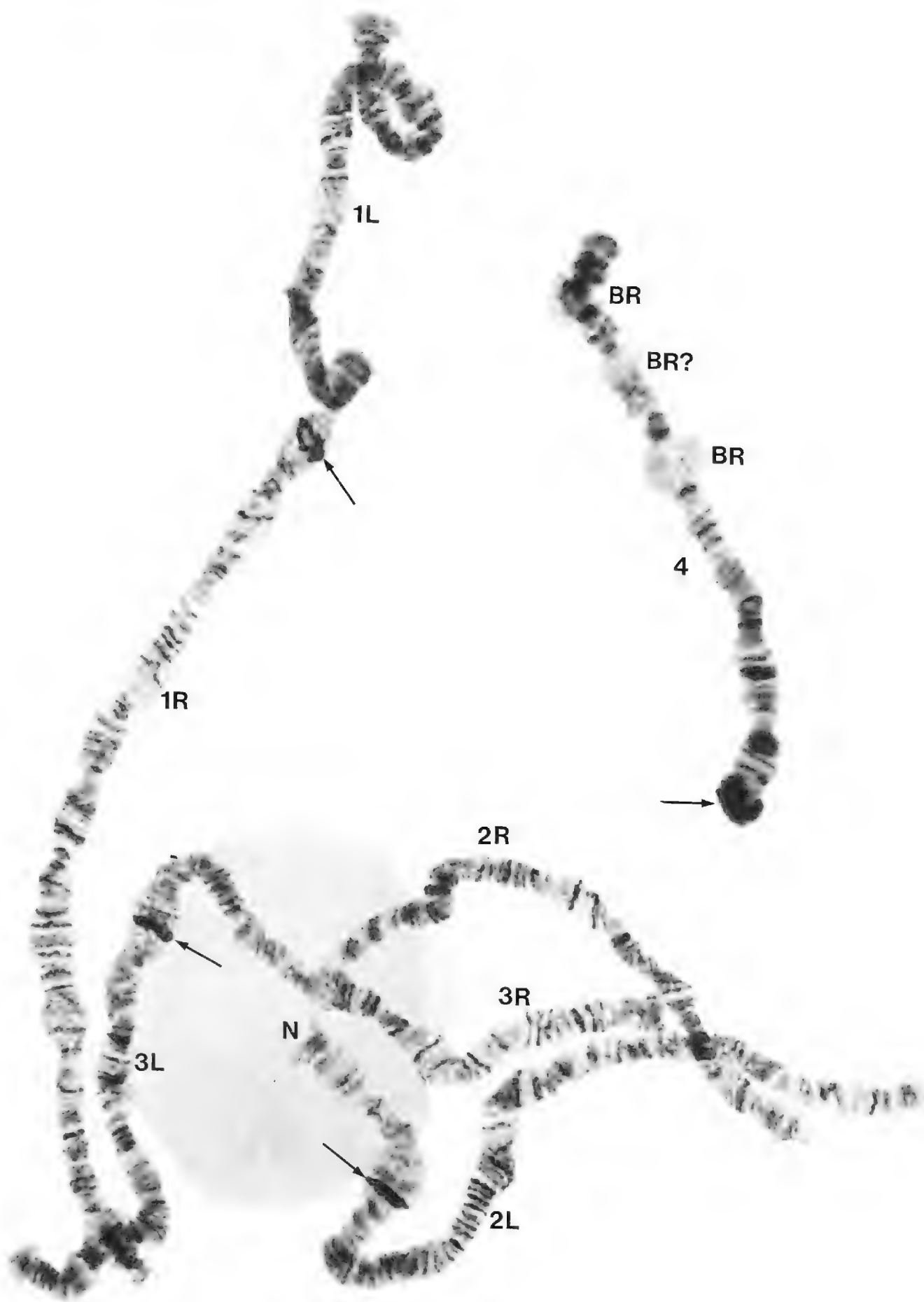


Fig. 10. Salivary gland chromosomes. Presumptive centromeres are indicated by an arrow; N, Nucleolus; BR, Balbiani ring.

labral structures, Figs. 4c, d, e. Mandible, Fig. 8b. Anterior prolegs, Fig. 4f. Ventral tubuli lacking. Anal tubuli almost half as long as the posterior prolegs, Fig. 5a, posterior prolegs each with 14–15 curved hooks, Fig. 5b. Preanal papillae with 6–8 long setae.

Pupa.—Color of exuviae largely pale with a lateral dark band from terga II–VIII which becomes progressively broader posteriorly, Fig. 9a, b. Swim fin largely dark. Total length, 5.42–5.99 mm (5♂); 6.66–7.68 mm (3♀). Respiratory organ with 2–3 basal branches (Fig. 5c). Cephalic tubercle dark, with very small apical spine and a subterminal seta (Fig. 5d). Cephalothorax papillose anteriorly (Fig. 5c). Abdomen with weak chagrin. Terga III–VI with similar patterns of chagrin; on each basally is a broad, weak patch of chagrin which tapers posteriorly joining the heavier transversely oriented posterior band (Figs. 5e, f, 6a); on tergum VI the bands are usually narrowly separated, Fig. 6a. Terga VII and VIII with weak chagrin near the base, Figs. 6b–e. Chaetotaxy, Figs. 9a, b. Tergum II with the posterior hook row interrupted across the middle (Fig. 6f); each half with about 12 hooks, Fig. 6g. Posteriolateral margin of tergum VIII with a simple to bifurcate spur (Figs. 6h, 8c). Anal fin with 94–102 flattened setae.

The 4th instar larva can be distinguished from most species of *Chironomus* by the smaller size (less than 10 mm) and lack of ventral tubuli. The labral structures, hypostomial plate and mandible are indistinguishable from *Chironomus*. The pupa is also extremely similar to *Chironomus* but differs most noticeably in the interrupted hook row of tergum II. The chagrin seems to be lighter than most members of the genus and the posteriolateral spur with 1–2 points also differs from most species.

Cytology.—*Yama tahitiensis* has four polytene chromosome elements, as is typical of most Chironomini species. These chromosomes have been numbered from 1 to 4 on the basis of relative length, from longest to shortest. Each chromosome has a thick heterochromatic band (Fig. 10) which, on the basis of observations on other chironomid species (e.g. Keyl, 1962), probably indicate the position of the centromeres. On this assumption, chromosomes 1 to 3 are metacentric or submetacentric, while 4 is acrocentric. In submetacentric chromosomes the shorter arm is designated as the left arm. In general the polytene chromosomes are long and thin and of relatively poor quality. In the better preparations some features can be recognized.

Chromosome 1 is almost metacentric but the left arm is slightly shorter. There are few obvious markers on this chromosome other than two constrictions near the center of the right arm.

Chromosome 2 is almost the same length as chromosome 1 and is metacentric. It is readily recognized by a nucleolus about one quarter of the arm length from the centromere in the right arm. There is an extensive group of even bands about a similar distance from the centromere in the left arm.

Chromosome 3 is about two thirds of the length of chromosome 1 or 2.

It is definitely submetacentric with the left arm only three quarters the length of the right arm. The left arm shows a distinct puff near the end and a group of three dark bands near the center. The right arm shows numerous bands near the centromere but the distal half is relatively pale with few distinct bands.

Chromosome 4, which is about one third the length of chromosome 1, is presumably acrocentric since a heterochromatic band, assumed to be the centromere, occurs at one end (Fig. 10). At least two, and possibly three, Balbiani rings are present about equally spaced from each other at the other end of the arm. A number of dark bands or band groups occur along the length of the arm.

No inversion polymorphism was found in any of the ten specimens examined.

Literature Cited

- Edwards, F. W. 1933. Some Tahitian Mycetophilidae and Chironomidae. Bull. Bishop Mus., 113:85-86.
- Hansen, Dean Cyrus, and Edwin F. Cook. 1976. The Systematics and Morphology of the Nearctic Species of *Diamesa* Meigen 1835 (Diptera: Chironomidae). Mem. Amer. Entomol. Soc. No., 30:1-203.
- Hirvenoja, M. 1973. Revision der Gattung *Cricotopus* van der Wulp und ihrer Verwandten (Diptera, Chironomidae). Ann. Zool. Fennici, 10:1-363.
- Keyl, H. G. 1962. Chromosomenevolution bei *Chironomus*. II. Chromosomenumbauten und phylogenetische Beziehungen der Arten. Chromosoma, 13:464-514.
- Keyl, H. G., and I. Keyl. 1959. Die cytologische Diagnostik der Chironomiden. I. Bestimmungstabelle für die Gattung *Chironomus* auf Grund der Speicheldrüsen-Chromosomen. Arch. Hydrobiol., 56:43-57.
- Wülker, W. F., J. E. Sublette, M. F. Sublette, and J. Martin. 1971. A review of the genus *Chironomus* (Diptera, Chironomidae) I. The *staegeri* group. Stud. Nat. Sci. (Portales, N.M.), 1(1):1-89.

BOOK REVIEW

American Spiders, Second Edition by Willis J. Gertsch, Ph.D. 288 pages plus index; illustrated; 6 × 9; Van Nostrand Reinhold; \$24.95. Publication date: January, 1979.

It has been thirty years since the first edition of Willis Gertsch's "American Spiders" was published. Dr. Gertsch, Curator Emeritus of the Department of Insects and Spiders of the American Museum of Natural History in New York, is the dean of American arachnologists. This new edition of his book follows closely the format of its predecessor, treating in an eminently readable style the natural history of spiders with examples drawn from representative American species. Such topics as life history, silk spinning, courtship and mating, and evolution are discussed. The second half of the book covers the various major types of spiders group by group, but not in the sense of an identification manual. There are in this edition, as in the earlier one, final chapters on economic and medical importance and the relationship of our fauna with that of the Old World. Only a small percentage of the text is actually new; new material has been inserted as an occasional sentence or paragraph where recently acquired knowledge has warranted it. Taxonomy and nomenclature have been brought up to date.

The color plates of the first edition have been omitted in favor of two new sections of exquisitely printed color photographs of spiders. The gravure photographs have been retained with a few additions, but the quality of reproduction is inferior to that of the old book. Some of the photographs have been unwittingly printed upside down (a black widow with egg sac in its web) or rotated 90° (the web of *Frontinella communis*), which is as bizarre to the initiated as a picture of a sleeping bat turned upside down. The text itself has a few typographical errors, the most serious of which is a transposition of lines in the section on molting.

Dr. Gertsch himself has been an important contributor to the advance of our knowledge of spiders, and this interesting book will help introduce a new generation to the study of spiders and perhaps entice new students into the growing ranks of araneologists.

Marjorie J. Moody, Systematic Entomologist, *California Department of Food and Agriculture*.

ZOOLOGICAL NOMENCLATURE

ITZN 59

June 1979

The following *Opinions* have been published recently by the International Commission on Zoological Nomenclature in the *Bulletin of Zoological Nomenclature*, Volume 35, part 4, 31 May 1979.

Opinion No.

- 1118 (p. 212) Conservation of *Tribolbina carnegiei* Latham, 1932 (Arachnida).
1119 (p. 216) *Amaurobius* C. L. Koch, 1837, and *Coelotes* Blackwell, 1841 (Araneae): conserved under the plenary powers.
1120 (p. 221) *Noctua armigera* Hübner [1808] (Lepidoptera) conserved.

The Commission regrets that it cannot supply separates of *Opinions*.

ITZN 59

July 1979

The following *Opinions* have been published recently by the International Commission on Zoological Nomenclature in the *Bulletin of Zoological Nomenclature*, Volume 36, part 1, 1 July 1979.

Opinion No.

- 1125 (p. 22) *Ceratophyllus soricis* Dale, 1878 (Insecta: Siphonaptera): designation of a neotype under the plenary powers.

The Commission regrets that it cannot supply separates of *Opinions*.

% British Museum (Natural History), Cromwell Road,
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ZOOLOGICAL NOMENCLATURE

ITZN 59

The following Opinions have been published recently by the International Commission on Zoological Nomenclature in the *Bulletin of Zoological Nomenclature* Volume 36.

Opinion No.

- 1128 (p. 73) *Platyrhacus* Koch, 1847 (Diplopoda): designation of *Platyrhacus fuscus* Koch, 1847 as type species.
- 1130 (p. 79) *Lilioceris* Reitter, 1912 (Insecta: Coleoptera): correction of type species.
- 1134 (p. 102) *Zerynthia* Ochsenheimer, 1816 (Insecta: Lepidoptera): conserved under the plenary powers.
- 1136 (p. 107) *Cicadetta strepitans* Kirdaldy, 1909 (Insecta: Homoptera): conserved.
- 1137 (p. 109) *Aphis gossypii* Glover, 1877 (Insecta: Homoptera): validated under the plenary powers.
- 1142 (p. 125) Family group names based on *Platystoma* Meigen, 1803 given precedence over those based on *Achias* Fabricius, 1805 (Diptera).
- 1143 (p. 130) *Kerrichiella* Rosanov, 1965 (Hymenoptera): designation of a type species under the plenary powers.
- 1144 (p. 132) *Phloeotribus* (Coleoptera: SCOLYTIDAE) ruled to be a justified emendation of *Phloiotribus* Latreille, 1796.
- 1145 (p. 149) *Dryocoetes* Eichhoff, 1864 (Coleoptera: SCOLYTIDAE): conserved under the plenary powers.
- 1146 (p. 151) *Xyleborus* Eichhoff, 1864 (Coleoptera: SCOLYTIDAE): conserved under the plenary powers.

The Commission regrets that it cannot supply separates of Opinions.

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